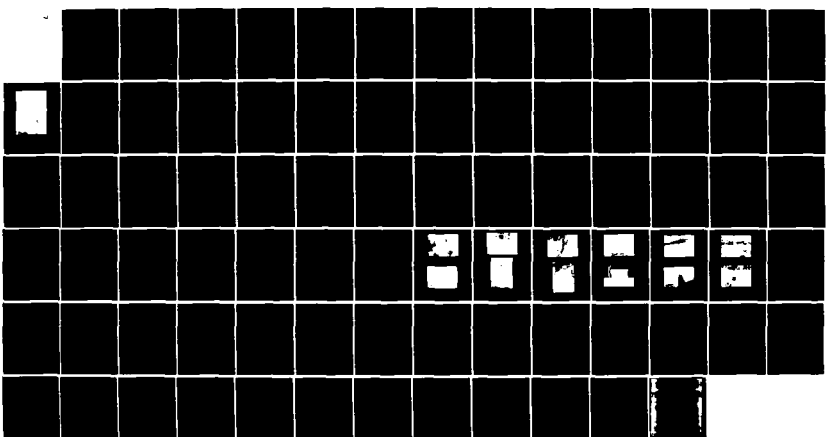
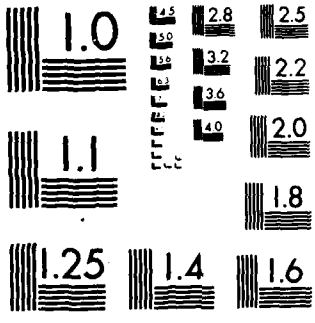
AD-A143 043 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
BRANFORD SUPPLY PONDS..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 81

UNCLASSIFIED F/G 13/13 NL





CONNECTICUT COASTAL

BRANFORD, CONNECTICUT

BRANFORD SUPPLY PONDS DAM
CT 00116

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

APRIL 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: CT 00116	2. GOVT ACCESSION NO.: AD-A143 043
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): Conn. Coastal Branford, Conn., Branford Supply Ponds Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s):
9. PERFORMING ORGANIZATION NAME AND ADDRESS:	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254	12. REPORT DATE: April 1981
	13. NUMBER OF PAGES: 60
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office):	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Conn. Coastal
Branford, Conn.
Branford Supply Ponds Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Branford Supply Ponds Dam is a stone masonry dam with bedrock outcrop wbutments and concrete gatehouse. The total length of the dam is 170 ft., which includes a 62 ft. long stone spillway located at the right end of the dam. The dam is 5 ft. wide and has a maximum height of 17.5 ft. There is a 12 ft. wide by 15 ft. long concrete gatehouse located 55 ft. from the left abutment of the dam. There are two 16 inch outlet pipes exiting from the gatehouse, one of which formerly served as a service water pipe. The maximum storage capacity of the dam with water at the top of dam is 202 acre-feet.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

JUL 09 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Branford Supply Ponds Dam (CT-00116) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Protection, and to the owner, Town of Branford, Branford, CT. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Protection for your cooperation in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

BRANFORD SUPPLY PONDS DAM

CT 00116

CONNECTICUT COASTAL

BRANFORD, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.	:	CT 00116
Name of Dam	:	Branford Supply Ponds Dam
Town	:	Branford
County and State	:	New Haven County, Connecticut
Stream	:	Pisgah Brook
Date of Inspection	:	November 20, 1980

BRIE ASSESSMENT

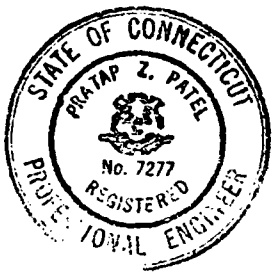
Branford Supply Ponds Dam is a stone rubble masonry dam with bedrock outcrop abutments and concrete gatehouse. The total length of the dam is 170 feet, which includes a 62 foot long stone spillway located at the right end of the dam. The dam is 5 feet wide and has a maximum height of 17.5 feet. There is a 12 foot wide by 15 feet long concrete gatehouse located 55 feet from the left abutment of the dam. There are two 16 inch outlet pipes exiting from the gatehouse, one of which formerly served as a service water pipe. The maximum storage capacity of the dam with water at the top of dam is 202 acre-feet. The present use of the ponds is strictly for recreation.

The visual inspection of Branford Supply Ponds Dam indicated that the dam is in fair condition. The inspection revealed extensive seepage was occurring at the masonry joints across the downstream face of the dam. The area along the entire downstream toe is wet and spongy with standing water in some areas. The gatehouse was open to trespass and had several large cracks in the walls and a deteriorated roof slab. In addition, the gate valves were unpainted and ungreased and the gate chamber was flooded.

Based on its small size and significant hazard classification and in accordance with the Corps guidelines the test flood selected was the 100 year flood. The peak inflow to the dam is 7700 cfs based on a drainage area of 3.85 square miles and a peak inflow factor of 2000 cfs per square mile for rolling terrain. The peak test outflow from the dam is 1600 cfs. The spillway capacity is 450 cfs or 28% of the peak outflow. The dam will be overtopped by 1.75 feet with the resulting pool elevation of 26.35 NGVD for the test flood.

In accordance with the findings of the visual inspection and hydrologic and hydraulic analysis, there is need for further engineering studies. Provisions should be made by the owner to retain the services of a qualified professional engineer to investigate the seepage on the downstream face of the dam. This should include determining if there is seepage occurring underneath the dam. In addition, the adequacy of the repairs made to the dam's cutoff five years ago should be investigated. The source of the flooding in the gate chamber should be determined and eliminated. A detailed hydrologic and hydraulic analysis to assess further the need for and means to increase the project discharge capacity and the ability of the dam to withstand overtopping should be made. Remedial measures to be taken include removing trees within 10 feet of the dam and those overhanging the spillway and outlet channels; monitoring the seepage from the dam; and securing the gatehouse, painting and greasing the gate valves and repairing the cracks and spalling on/in the gatehouse.

The recommendations and remedial measures are described in Section 7 and should be addressed within one year after receipt of this Phase I Inspection Report by the owner.



Pratap Z. Patel, P.E.
Project Manager

Pratap Z Patel

Philip W. Genovese & Associates, Inc.
Hamden, Connecticut

This Phase I Inspection Report on Branford Supply Ponds Dam (CT-00116) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at

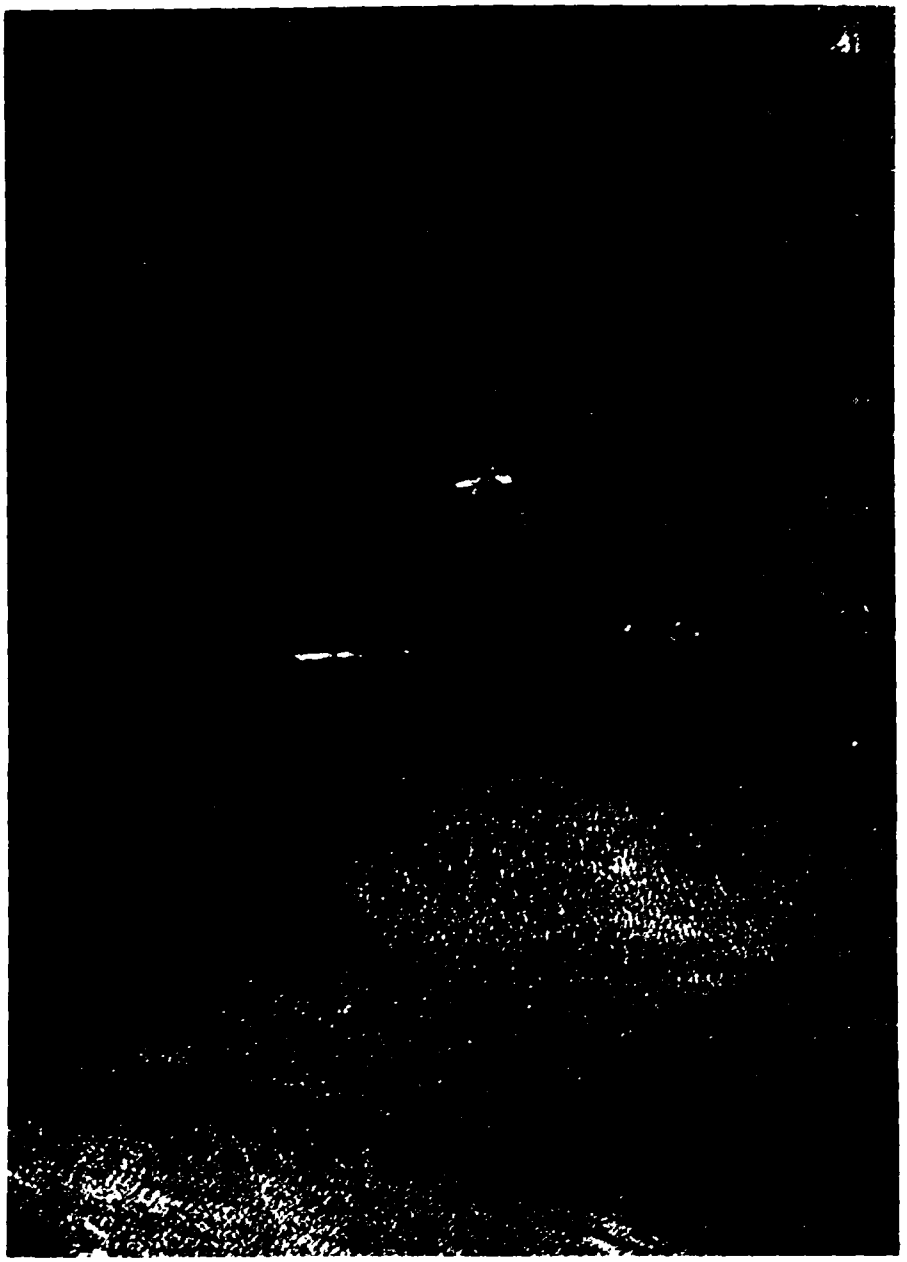
some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flodd provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

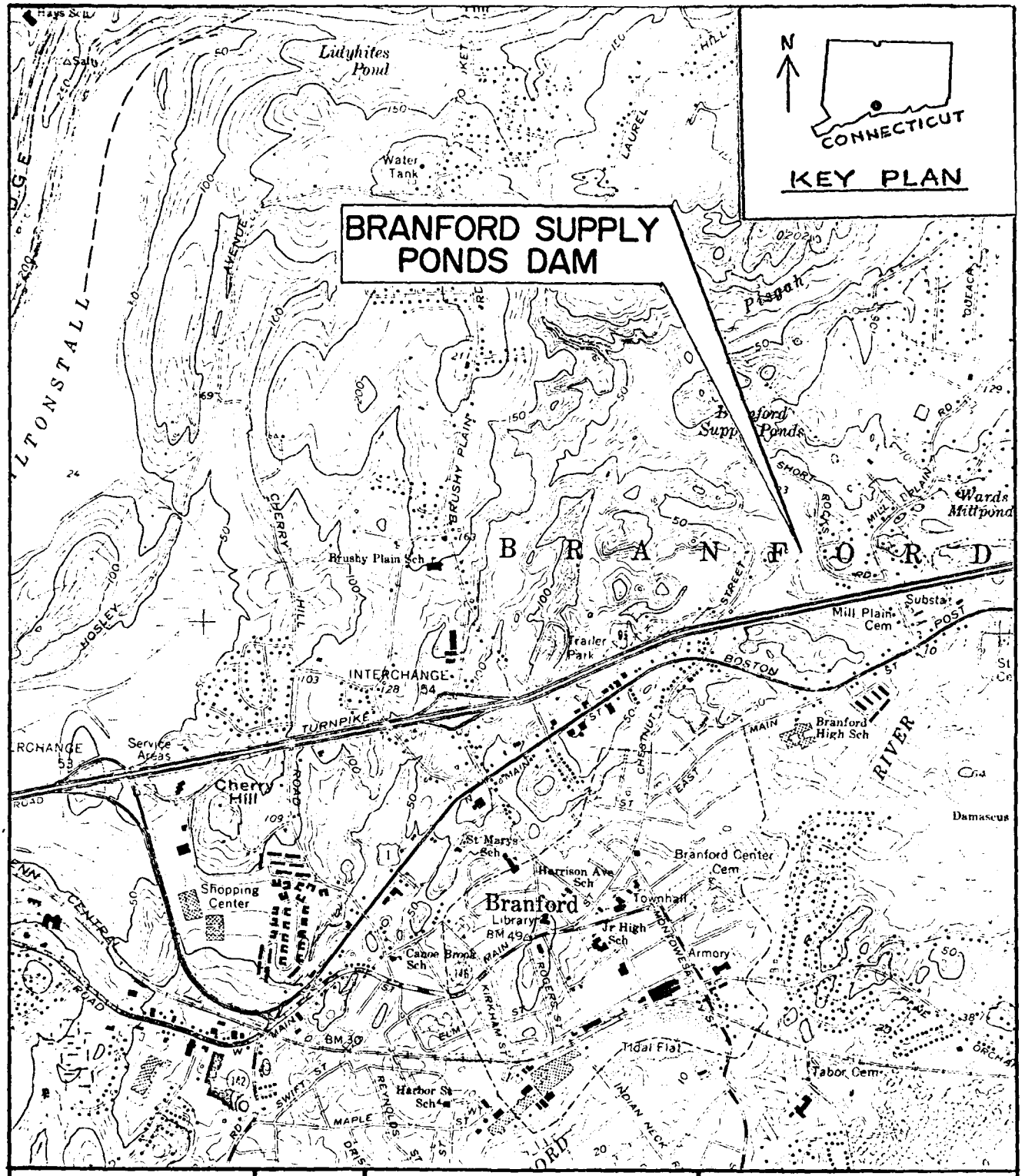
The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

REPORT



U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	OVERVIEW PHOTO DECEMBER, 1980 BRANFORD SUPPLY PONDS DAM PISGAH BROOK BRANFORD, CONNECTICUT
PHILIP W. GENOVESE AND ASSOCIATES, INC. ENGINEERS - HAMDEN, CT.		



USGS QUAD BRANFORD, CT.	N	PHILIP W. GENOVESE AND ASSOCIATES, INC. ENGINEERS - HAMDEN, CT.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
SCALE IN FEET 0 1000 2000 3000 4000		NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS LOCATION MAP	

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

BRANFORD SUPPLY PONDS DAM - CT 00116

SECTION I

PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Philip W. Genovese and Associates, Inc. has been retained on selected dams in South Central Connecticut. Authorization and notice to proceed were issued to Philip W. Genovese and Associates, Inc. under a letter of November 17, 1980 from Colonel William E. Hodgson Jr., Corps of Engineers. Contract No. DACW 33-81-C-0017 has been asssigned by the Corps of Engineers for this work.

b. Purpose

1. Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2. Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3. Update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Branford Supply Ponds Dam is located in the Town of Branford, in New Haven County, Connecticut. The Branford Supply Ponds are north of the Connecticut Turnpike near the intersection of Mill Plain Road and Short Rocks Road, The dam impounds the waters of Pisgah Brook, and is shown on the Branford, Connecticut Quadrangle with the approximate coordinates of North 41° 17.7' West 72° 48.1'. Pisgah Brook joins the Branford River approximately 0.5 mile downstream of the dam.

b. Description of Dam and Appurtenances

Branford Supply Ponds Dam is a stone rubble masonry dam with concrete abutments and concrete gatehouse. The total length of the dam is 170 feet, which includes a 62 foot long stone spillway. The maximum height of the dam is 17.5 feet. There are two 15-inch movable screened intakes which join to form a 16-inch pipe which outlets 200 feet downstream of the dam. There is a considerable amount of ledge in the area, particularly at the east end of the dam and east of the spillway. Also, there is loose rock in the discharge channel. There is a concrete gatehouse located 40 feet from the east end of the spillway, and the chamber houses operable gates and has two outlet pipes. There is a 6-inch vent pipe which runs through the wall at a height five feet above the concrete floor. A wooden foot bridge 30 feet long and 5 feet wide spans the discharge channel 150 feet downstream from the dam. There are rubble masonry retaining walls running from the abutments at each end of the spillway down the slope to the downstream channel.

c. Size Classification

The dam's maximum impoundment of 202 acre-feet and height of 17.5 feet places it in the SMALL category, using as a reference the size classification table in the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams. Table 1 of these guidelines classifies a dam with 50 to 1000 acre-feet of storage as being small in size.

d. Hazard Classification

The hazard potential classification for this dam is SIGNIFICANT, using the Corps Guidelines, because there are 3 homes within one-half mile south of the dam which would experience increased flooding to a depth of 4 to 5 feet as a result of dam-breach conditions. Also, the dam is in close proximity to the Connecticut Turnpike, Mill Plain Road and Cemetery, and Short Rocks Road. A dam breach could result in the loss of a few human lives.

e. Ownership

The dam is owned by the Town of Branford, Connecticut, and the address is:

Town of Branford,
c/o Engineering Department
1019 Main Street
Branford, Connecticut 06405

Telephone: 203-488-1651

f. Operator

The operation of the dam is controlled by the Engineering Department of the Town of Branford, The Town Engineer is Donald Ellis, and the Department's telephone number is 203-488-1651.

g. Purpose of Dam

The present purpose of the dam is for recreation.

h. Design and Construction History

This dam was built by the Branford Electric Company in 1911, sold to the New Haven Water Company in 1920 and transferred to the Town of Branford, the present owner, in 1971. Some repair work was done by the town road crew in the early seventies, involving plugging a substantial leak and repointing walls, but no records of this work are now available.

Very little design information can be located. The Town has a plan of the gate house which was traced from a Water Company print in 1972. There is a Water Company property map of the area revised to 1974, and contour maps on file in the office of the Branford Town Engineer.

i. Normal Operational Procedures:

Due to vandalism at the site in the past the control wheels to the gate valves have been removed by the Town. Only during repairs which necessitate dewatering the pond or in heavy storms which may cause flood conditions, are the wheels brought to the site to open the gate valves. However, there is no established formal plan for this action.

1.3 Pertinent Data

a. Drainage Area

The drainage area for this dam covers 3.85 square miles, or 2464 acres. The Supply Ponds are fed by the waters of Pisgah Brook, which runs through a wide swampy area northeast of the dam for nearly two miles. The brook also carries water from other ponds located to the north and the drainage from a steep wooded area north of the swamps. Downstream of the dam the brook runs under the Connecticut Turnpike (Interstate 95) and the Boston Post Road and outlets into Branford River. The immediate area of the dam is sparsely populated, there being two houses and two commercial buildings along the Post Road in the vicinity of Pisgah Brook.

b. Discharge at Damsite

1. The outlet works for the ponds consist of two adjustable screened 15 inch pipes which join to form a 16 inch pipe. In addition; there is a separate 16 inch pipe. The two 15 inch pipes are located at approximately invert elevation 7.1 and formerly served as part of the town's water supply. The other 16 inch pipe has an invert elevation of 8.5 and is the original dam outlet. All three intakes are controlled by valves in the gatehouse. The total discharge capacity of the outlet works is 90 cfs with water at the top of dam.

2. There are no records of maximum discharge at the dam site. In 1955, though, the water level was close to the top of the dam indicating a discharge of 450 cfs.

3. The ungated spillway capacity at top of dam elevation of 24.6 is 450 cfs.

4. The ungated spillway capacity at test flood elevation of 26.35 is 1600 cfs.

5. The gated spillway capacity at normal pool elevation of 22.8 is N/A.

6. The gated spillway capacity at test flood elevation is N/A.

7. The total spillway capacity at test flood elevation of 26.35 is 1600 cfs.

8. The total project discharge at top of dam elevation of 24.6 is 540 cfs.

9. The total project discharge at test flood elevation of 26.35 is 1690 cfs.

c. Elevation (Feet above NGVD)

1. Streambed at toe of dam	7.1
2. Bottom of Cutoff	Unknown
3. Maximum tailwater	Unknown
4. Normal pool	22.8
5. Full flood control pool	N/A
6. Spillway crest	22.8
7. Design surcharge	Unknown
8. Top of dam	24.6
9. Test flood surcharge	26.4

d. Reservoir (Length in feet)

1. Normal pool	3600
2. Test Flood pool	8625
3. Flood control pool	N/A
4. Spillway crest pool	3600
5. Top of dam	5700

e. Storage (Acre-feet)

1. Normal pool	126
2. Spillway crest pool	126
3. Flood control pool	N/A
4. Top of dam	202
5. Test flood pool	335

f. Reservoir Surface (Acres)

1. Normal pool	24
2. Flood control pool	N/A
3. Spillway crest pool	24
4. Test flood pool	96
5. Top of dam	60

g. Dam

1. Type	Rubble masonry
2. Length	175 feet
3. Height	17.5 feet
4. Top Width	5 feet
5. Side slopes	Upstream (Vertical)

5. (Con'd from 1-5)	Downstream (upper 10 feet 1 horizontal to 1.5 vertical, lower portion 1 horizontal to 1.4 vertical)
6. Zoning	Unknown
7. Impervious Core	Unknown
8. Cutoff	According to owner, dam is founded on bedrock
9. Grout curtain	Unknown

h. Diversion and Regulating Tunnel — None

i. Spillway

1. Type	Rubble Masonry
2. Length of weir	62 feet
3. Crest elevation	22.8
4. Gates	None
5. Upstream Channel	Not Visible (elevation 9.3)
6. Downstream Channel	Rock lined (elevation 7.1)

j. Regulating Outlets

1. Invert	8.5
2. Size	16-inch
3. Description	16-inch pipe which runs straight through the gatehouse
4. Control mechanism	Gate valves which are in poor condition, but still operable
5. Other	2-15-inch movable screened intakes which join to form a 16-inch pipe outletting approximately 200 feet downstream of the dam

SECTION 2

ENGINEERING DATA

2.1 Design

No original design drawings were found of this dam. There was one tracing of the design drawing of the outlet works which was obtained from the Town Engineers. Prior to the Town owning, it was the property of the Branford Electric Company, and more recently, the New Haven Water Company. The dam was built in 1911 and as detailed in Section 3.1 of this report, was modified approximately five years ago. There were no drawings or records kept of these alterations. No in-depth engineering data were found for this dam.

2.2 Construction

No construction records were available for use in evaluating the dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability

No reliable engineering data was found to be available.

b. Adequacy

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity

The lack of engineering plans eliminates a judgment of validity.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General

The field inspection of Branford Supply Ponds Dam was made on November 20, 1980. The inspection team consisted of personnel from Philip W. Genovese and Associates, Inc., Geotechnical Engineers, Inc., and Diversified Technologies Corporation. Two representatives of the Town of Branford were in attendance for a portion of the inspection. These were Mr. Don Ellis, Town Engineer and Mr. Ed Doheny. Inspection checklists, completed during the visual inspection are included in Appendix A. At the time of the inspection the water level was approximately 0.15 feet above the permanent spillway elevation and water was passing over the spillway. The upstream face of the dam could only be inspected above this water level.

b. Dam

The dam is a stone block masonry dam 17.5 feet high, 170 feet long, and 5 feet wide at the crest. A stationing system was developed for the visual inspection. The junction of the crest of the dam and the left abutment corresponds to Sta 0 +45, and the station numbers increase to the right of this point. A gatehouse is located on the crest of the dam between Sta 1 + 00 and Sta 1 + 15. A spillway is located between the dam and the right abutment between Sta 1 + 53 and Sta 2 + 15.

The owner's representative indicated that about 5 years ago a large amount of water was exiting through the outlet channel downstream from the gatehouse even when the outlet gates were closed. The reservoir level continuously dropped except during periods of rainfall and runoff after which the reservoir level continued dropping. The reservoir was drained in order to investigate the dam. It was determined that most of the dam is founded on bedrock which forms a V-shaped valley. However, at the bottom of the valley, the dam is founded on sand and gravel for a distance of 8 feet parallel to the axis of the dam. In some areas voids were observed in the sand and gravel. At the direction of the owner the sand and gravel was excavated from under the dam from the upstream toe to about 10 feet downstream from the upstream

toe and replaced with concrete. After the reservoir was refilled, the owner's representative indicated that the reservoir level could be maintained.

At the time of the visual inspection extensive seepage was occurring between the stone blocks across the downstream face of the dam as indicated in Photos No. 3, 5 and 6. At about Sta 1 + 28 water is spurting out about 9 feet below the crest of the dam. The upper 4 feet of the entire downstream face has been coated with a thin concrete veneer. It appears that most of the seepage is occurring underneath this veneer.

The area along the entire downstream toe is wet and spongy with standing water in some areas as a result of the water flowing through the downstream face. However, it was not possible to determine how much of this water at the downstream toe is coming through the dam and how much is the result of seepage underneath the dam. At about Sta 1 + 45 a 10-inch diameter tree is growing about 2.5 feet downstream from the downstream toe.

The left and right sides of the dam are in contact with bedrock outcrops. No evidence of seepage was observed at these contacts at the time of the visual inspection.

c. Appurtenant Structures

Visual inspection of the spillway and spillway channel did not reveal any evidence of instability problems. The masonry training walls appeared in fair condition with some cracking and spalling. These conditions are shown in Photo 10. Bedrock outcrops are exposed at both ends of the spillway.

There is a gatehouse and outlet works located on the dam. The outlet works are in poor condition. There is no lock on the gatehouse door and there is evidence of trespass. There are a number of significant cracks (maximum size 1/32 of an inch) in the walls of the gatehouse. A horizontal crack runs along the perimeter 5 feet above the floor. There are three vertical cracks - two at corners of north wall and one midway in south wall - starting at the floor to a distance of 5 feet. The gate valves are unpainted, ungreased and rusty, but are still operable. The gate chamber is flooded and therefore, inaccessible by the rusting ladder leading down to it. The outside of the gatehouse is cracking in a number of places and the roof slab has visible reinforcing. The vent pipe consists of a 6 inch pipe through the downstream gatehouse wall.

d. Reservoir Area

There are no indications of instability along the banks of the reservoir in the vicinity of the dam.

e. Downstream Channel

There are two downstream channels, one downstream from the spillway and the other downstream from the outlet works in the gatehouse. The two downstream channels are referred to as the spillway channel and the outlet channel, respectively, in the following sections. The two channels join about 85 feet downstream of the dam.

The floor of the spillway channel consists of bedrock covered with cobbles and boulders as shown in Photos No. 1 and 10. At about 25 feet and 60 feet downstream from the spillway crest the boulders and cobbles have been used to form two walls extending across the channel. A stilling basin has formed upstream of each wall. The spillway channel is bordered to the left by a stone masonry training wall that extends about 45 feet downstream from the spillway crest. To the right the channel is bounded by a two feet high stone wall along the right abutment.

The outlet channel is bounded by stone walls as shown in Photo 12. The floor of the channel is covered with cobbles. At about 85 feet downstream from the dam the outlet channel joins the spillway channel to form a single channel which consists of a natural streambed. In some areas large trees are overhanging the channels.

3.2 Evaluation

On the basis of the results of the visual inspection, Branford Supply Ponds Dam is judged to be in fair condition.

Seepage is occurring through the stone blocks in the dam along its entire downstream face. This condition will affect the long-term performance of the dam if not corrected.

It was not possible to determine if seepage is occurring underneath the dam. If seepage is occurring, it could lead to erosion of the soil beneath the center of the dam.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General

The dam creates an impoundment of the water which is used primarily for recreational purposes.

b. Description of any Warning System in Effect

There are no warning systems in effect at this facility.

4.2 Maintenance Procedures

a. General

There is no regular maintenance program for this dam.

b. Operating Facilities

Maintenance of operating facilities is not done on a regular basis.

4.3 Evaluation

The current operating and maintenance procedures for the dam are inadequate.

An Operating and Maintenance Manual should be prepared for the dam and operating facilities, and a program of annual technical inspections by qualified registered engineers should be instituted. A formal downstream warning system should be developed and put into effect in case of an emergency at the dam.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Branford Supply Ponds Dam has a 3.85 square mile tributary watershed, consisting of rolling to mountainous terrain, some of which is developed for residential use. The remainder of the watershed is mostly wooded and includes three ponds.

The maximum impoundment to the top of the dam (El. 24.6 NGVD) is estimated to be 202 Acre feet and estimated storage below the spillway crest is 126 Acre feet.

5.2 Design Data

Some drawings are available for the structure. However, no hydraulic or hydrologic design data could be found for this dam.

5.3 Experience Data

The maximum previous discharge at this dam is unknown.

5.4 Test Flood Analysis

According to the Corps of Engineers Recommended Guidelines for Safety Inspection of Dams Table 3, the test flood for this significant hazard and small dam could be in the 100 year to half Probable Maximum Flood (1/2 PMF) range. Based upon the involved downstream risk potential, a 100 year test flood was selected and the Corps of Engineers Guide Curves for a 3.85 square mile watershed of rolling to mountainous terrain yields a peak inflow of 2030 cfs. The peak outflow is estimated to be 1600 cfs with a maximum stage in the ponds at 26.35 NGVD and maximum surcharge above the spillway crest is estimated to be 3.55 feet. Thus, the dam is expected to be overtopped by 1.75 feet at the selected test flood condition. The spillway capacity with pool at top of dam is estimated to be 450 cfs which represents 28% of the routed test flood outflow. The discharge capacity of the 16 inch diameter low-level outlet is considered to be small and therefore is neglected in this analysis.

5.5 Dam Failure Analysis

Utilizing the Corps of Engineers April 1978 "Rule of Thumb Guidance for Estimating Downstream Failure Hydrographs" the peak

failure outflow due to dam breach is estimated to be 4700 cfs with an estimated flood depth of 7.7 feet immediately downstream of the dam. The breach width is estimated to be 34 feet which includes the gatehouse and the low-level outlet. The flood routing was performed for peak failure outflow with pool at top of dam.

The prefailure flow in the Brook is estimated to be 450 cfs with a depth of 3.5 feet and after failure, the flood stage is estimated to increase by 3.3 feet immediately upstream of Highway I-95. The first floor of three houses on Short Rocks Road are 9± feet above the Brook bed. The basement of these houses could be subjected to 4 to 5 feet of flooding. The I-95 Highway culvert does not have adequate capacity to pass the peak flow. This would cause some increase in flood depth due to damming effect of the highway embankment. However, the increase in flood depth is not expected to rise high enough to damage first floors of these three houses.

Further downstream, the estimated prefailure flow of 450 cfs in the Brook immediately upstream of Boston Post Road would have a depth of 3.4 feet and after failure the flood stage is estimated to increase by 3.8 feet. Two houses on Mill Plain Road are located only 6± feet above the Brook bed and hence these houses would be subjected to 1± feet of flooding. Also, three other commerical buildings on Post Road could have basement flooding. In addition, the Post Road culvert has inadequate capacity to pass the peak flow.

Based upon the hydraulic/hydrologic analysis (Appendix D) and the potential for loss of a few lives, the dam has a significant hazard classification.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The visual inspection did not disclose any immediate stability problems. However, the water seeping through the downstream face of the dam could affect the long-term stability of the dam. It was not possible to determine if the wet areas along the downstream toe of the dam are due solely to the water flowing through the downstream face or if some of the water is the result of seepage underneath the dam. If seepage is occurring underneath the dam, erosion of the underlying soil may occur.

6.2 Design and Construction Data

Due to the lack of design and construction data for this dam, the assessment of safety is based on the results of the visual inspection and on engineering judgment.

6.3 Post-Construction Changes

A concrete veneer has been placed on the upper 4 feet of the downstream face of the dam. As discussed in Section 3.1 the reservoir was drained five years ago and the sand and gravel below the center of the dam was partially excavated and replaced with concrete.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and, in accordance with Corps of Engineers' guidelines, does not warrant further seismic analysis at this time.

SECTION 7

ASSESSMENTS, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

On the basis of the visual inspection Branford Supply Ponds Dam is judged to be in fair condition.

b. Adequacy of Information

Due to lack of in-depth design and construction data for the dam, the assessment of safety is based on the results of the visual inspection.

c. Urgency

The recommendations presented in Section 7.2 and 7.3 should be implemented by the owner within one year after receipt of the Phase I report.

7.2 Recommendations

The owner should retain the services of a registered professional engineer qualified in the design and inspection of dams to accomplish the following:

1. Investigate design and implement methods to control the seepage on the downstream face of the dam.

2. Determine if seepage is occurring underneath the dam, and if so, design and put into effect any procedures which will correct this condition.

3. Investigate the adequacy of repairs made to dam five years ago, and supervise the making of any additional repairs deemed necessary.

4. Investigate the source of the flooding in the gate chamber, and put into effect the procedures believed necessary to eliminate this condition.

5. Perform a detailed hydrologic and hydraulic analysis to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity.

6. Repair cracking and spalling observed at the gatehouse.

7. Repair spalling and cracking of dam cap and left downstream training wall of spillway.

8. The existing tree growth within an area of 10 feet from the downstream toe of the dam should be removed by uprooting and the root zones backfilled with carefully selected soil, placed as directed by the Engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures

1. Remove trees growing within an area of 10 feet from the downstream toe of the dam, including root systems. Backfill holes with proper material.

2. Remove large trees overhanging the spillway and outlet channels within a distance of approximately 10 feet downstream of the dam.

3. Establish a monitoring program including observation and documentation of the seepage so that significant changes in flow can be detected. This inspection should be perfomed at both high and low reservoir levels and should be continued until the recommendations in Section 7.2 have been carried out.

4. Paint and grease the gate valves.

5. Inspect periodically the outlet box shown in Photo No. 11 to determine if it is functioning properly.

6. Prepare an Operating and Maintenance Manual for the dam and operating facilities.

7. Institute a program of annual technical inspections by qualified registered engineers.

8. Develop and put into effect a formal downstream warning system.

7.4 Alternatives

There are no practical alternatives to the recommendations and remedial measures noted in Section 7.2 and 7.3.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

TIME 0900

WEATHER Clear, 32°

W.S. ELEV. _____ U.S. ____ DN.S.

PARTY:

1. P. Patel - Genovese
2. W. Gancarz - Genovese
3. M. Atluru - DTC
4. R. Murdock - GEI
5. S. Whiteside - GEI
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Embankment	GEI	
2.	Outlet Structures	Genovese	
3.	Spillway	DTC	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE Geotechnical NAME RM, SW

	AREA EVALUATED	CONDITION
	DIKE EMBANKMENT	No embankment. Stone masonry dam.
	Crest Elevation	24.6
	Current Pool Elevation	22.8
	Maximum Impoundment to Date	
GEI	Surface Cracks	None observed.
GEI	Pavement Condition	No pavement.
GEI	Movement or Settlement of Crest	None observed.
GEI	Lateral Movement	None observed.
GEI	Vertical Alignment	Good.
GEI	Horizontal Alignment	Good.
GEI	Condition at Abutment and at Concrete Structures	Good.
GEI	Indications of Movement of Structural Items on Slopes	None observed.
GEI	Trespassing on Slopes	N/A.
GEI	Sloughing or Erosion of Slopes or Abutments	None observed.
GEI	Rock Slope Protection - Riprap Failures	No riprap observed.
GEI	Unusual Movement or Cracking at or near Toes	None observed.
GEI	Unusual Embankment or Downstream Seepage	Water seeping through downstream face of dam at many locations. Along the entire downstream toe the ground is wet and spongy with areas of standing water.
GEI	Piping or Boils	None observed.
GEI	Foundation Drainage Features	None observed.
GEI	Toe Drains	None observed.
GEI	Instrumentation System	None observed.
GEI	Vegetation	A 10 inch diameter tree is growing 2.5feet downstream of dam at about Sta 1 + 15.

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	No dike embankment.
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE Outlet Works - Intake NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Under water - not observed.
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE Outlet Works - Tower NAME

DISCIPLINE Civil/Str. NAME WG, PP

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair- Poor
Condition of Joints	Some cracking
Spalling	Yes
Visible Reinforcing	Yes - especially on roof.
Rusting or Staining of Concrete	Yes
Any Seepage or Efflorescence	Yes
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	No
Cracks	Yes - several large ones in walls (See Section 3.1 (c))
Rusting or Corrosion of Steel	Spindles and ladder are unpainted and rusting
b. Mechanical and Electrical	
Air Vents	6 inch open pipe thru wall
Float Wells	Outlet sluice chamber is flooded
Crane Hoist	N/A
Elevator	N/A
Hydraulic System	Fair-Good
Service Gates	Need greasing and painting
Emergency Gates	None observed
Lightning Protection System	None observed
Emergency Power System	None observed
Wiring and Lighting System	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE Outlet Works - Conduit NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Not visible.
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE Outlet works - Str./Channel NAME

DISCIPLINE Geotechnical/Civil/Str. NAME RM, SW, WG, PP

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Stone Box - Water seeping out.. Headwall only portion observable.
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
GEI Drain holes	None observed
GEI Channel	
GEI Loose Rock or Trees Overhanging Channel	Some rocks and trees overhanging channel.
GEI Condition of Discharge Channel	Good

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical/Civil/Str. NAME RM, SW, WG; PP

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Under water - not observed.
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	No
Spalling	Yes
Any Visible Reinforcing	No
Any Seepage or Efflorescence	Some
Drain Holes	None observed.
c. Discharge Channel	
General Condition	Good.
Loose Rock Overhanging Channel	Boulders piled in channel.
Trees Overhanging Channel	Some.
Floor of Channel	Bedrock covered with loose rock and boulders. Boulders are piled at about 25 feet and 60 feet downstream of spillway crest and form two stilling basins.
Other Obstructions	

GEI

GEI

GEI

GEI

GEI

PERIODIC INSPECTION CHECK LIST

PROJECT BRANFORD SUPPLY PONDS DAM DATE November 20, 1980

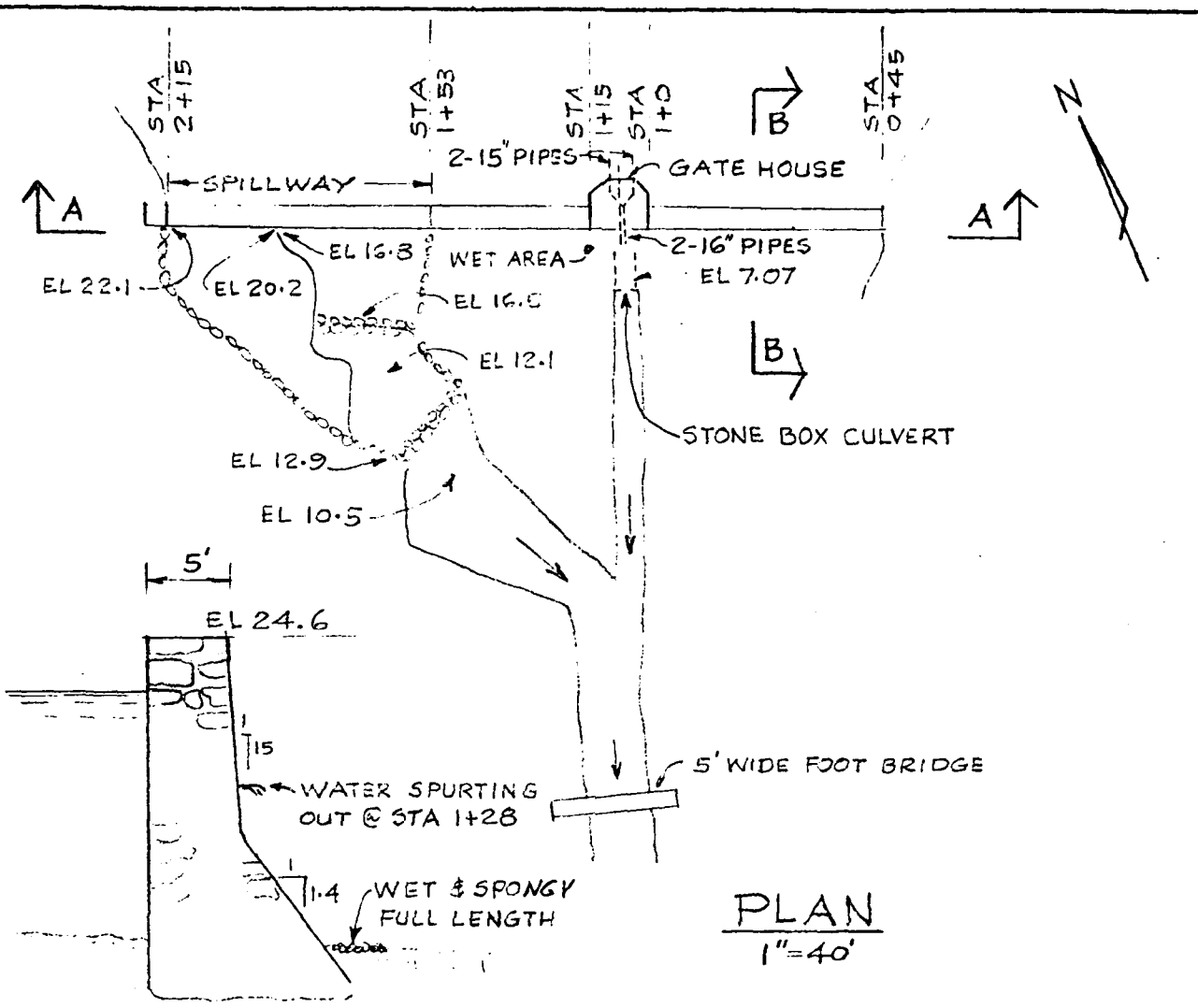
PROJECT FEATURE Outlet Works - Bridge NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	None observed.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

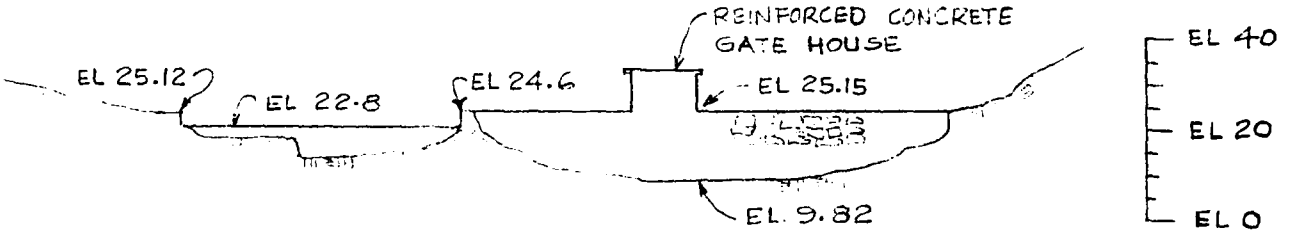
APPENDIX B

ENGINEERING DATA



PLAN
1"=40'

SECTION BB
1"=8'

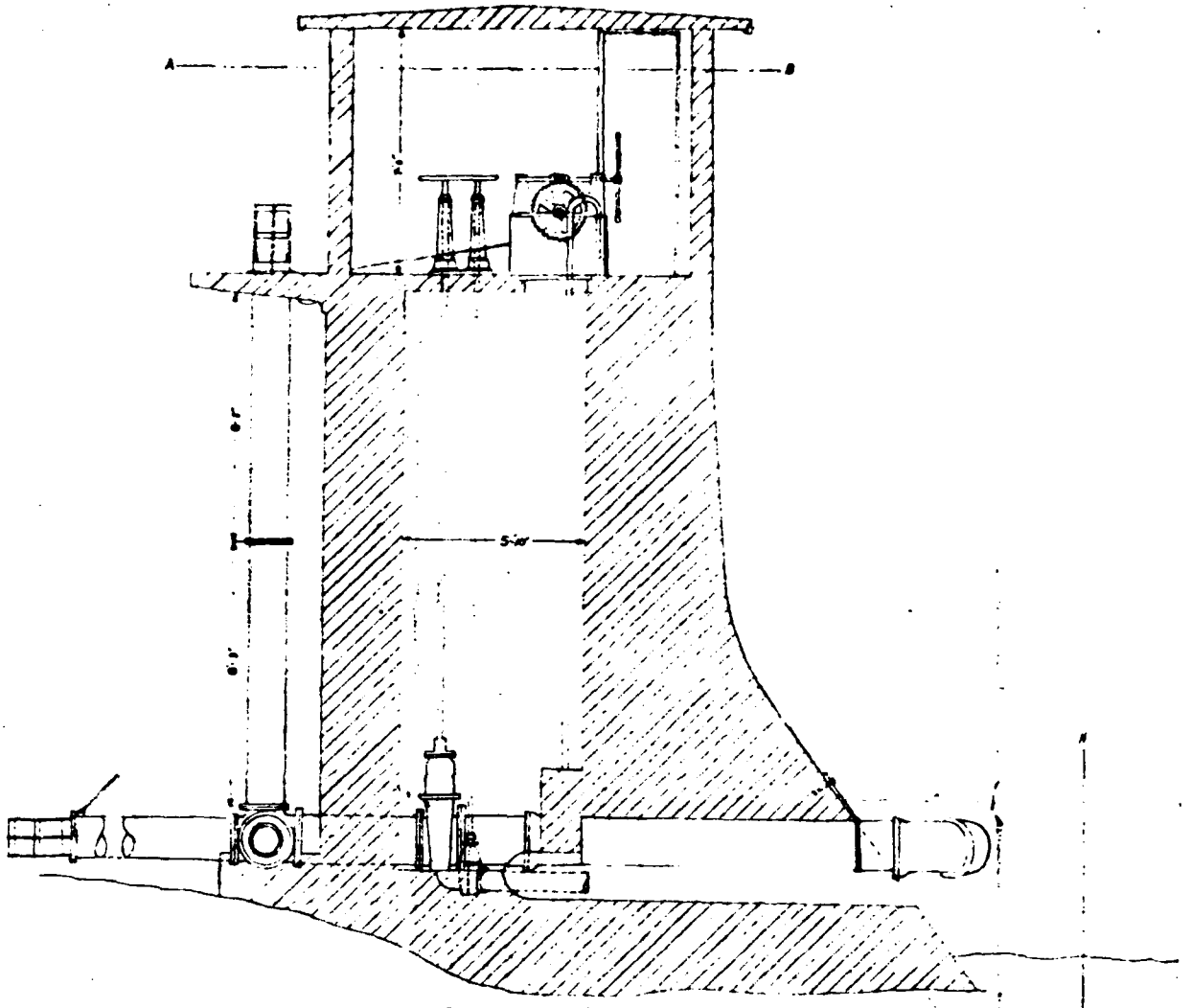


SECTION AA
1"=40'

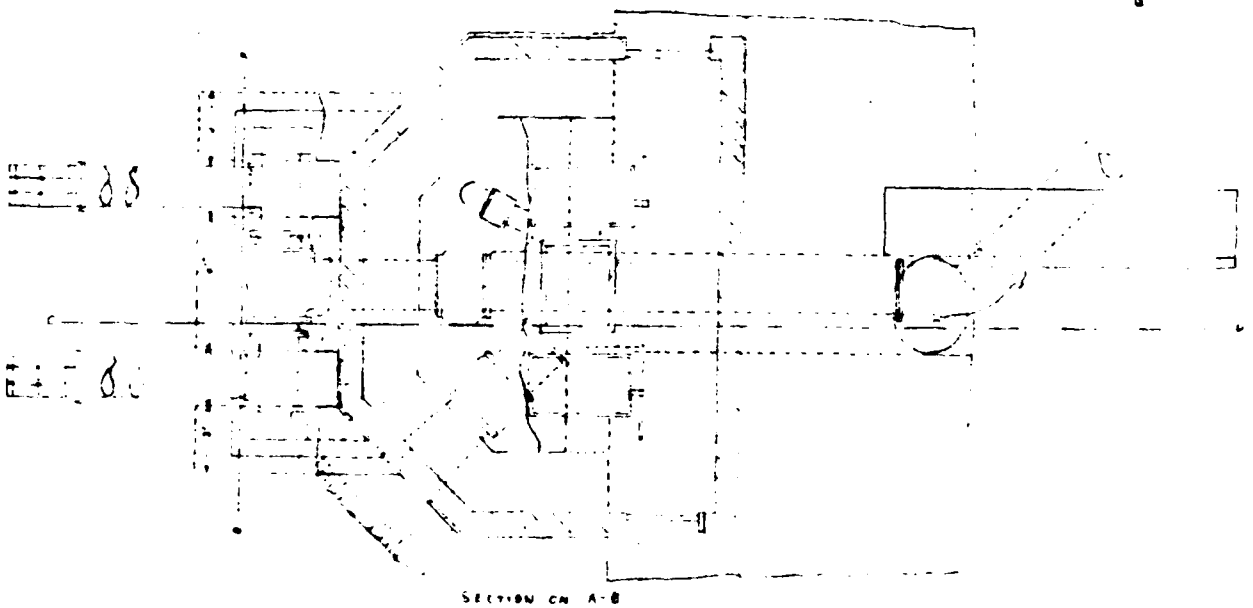
0 20 40 60 FT
SCALE 1"=40'

B-1

PHILIP W. GENOVESE & ASSOCIATES, INC. ENGINEERS HAMDEN, CONNECTICUT	BRANFORD SUPPLY PONDS DAM (CT00116)



Section C-D



SECTION ON A-B

B-2

Town of

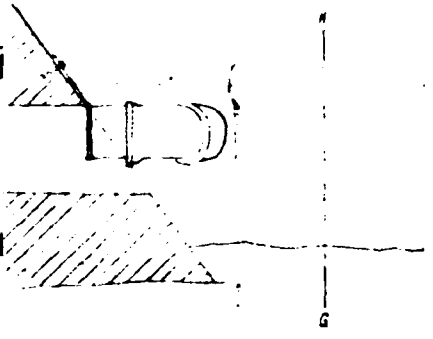
BRANFORD SUPPLY POND

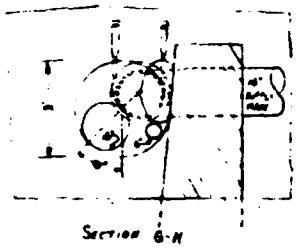
PLAN OF GATE HOUSE

TRACED FROM WATER COMPANY MAP

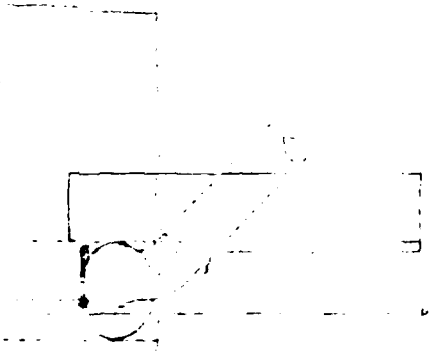
AUG 27 1972

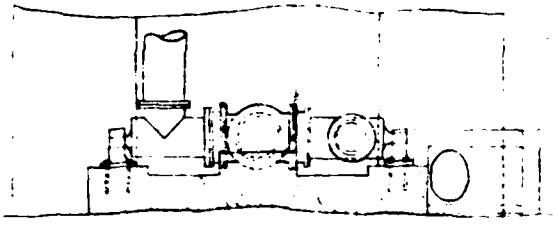
SCALE 1" = 2'





SECTION G-H





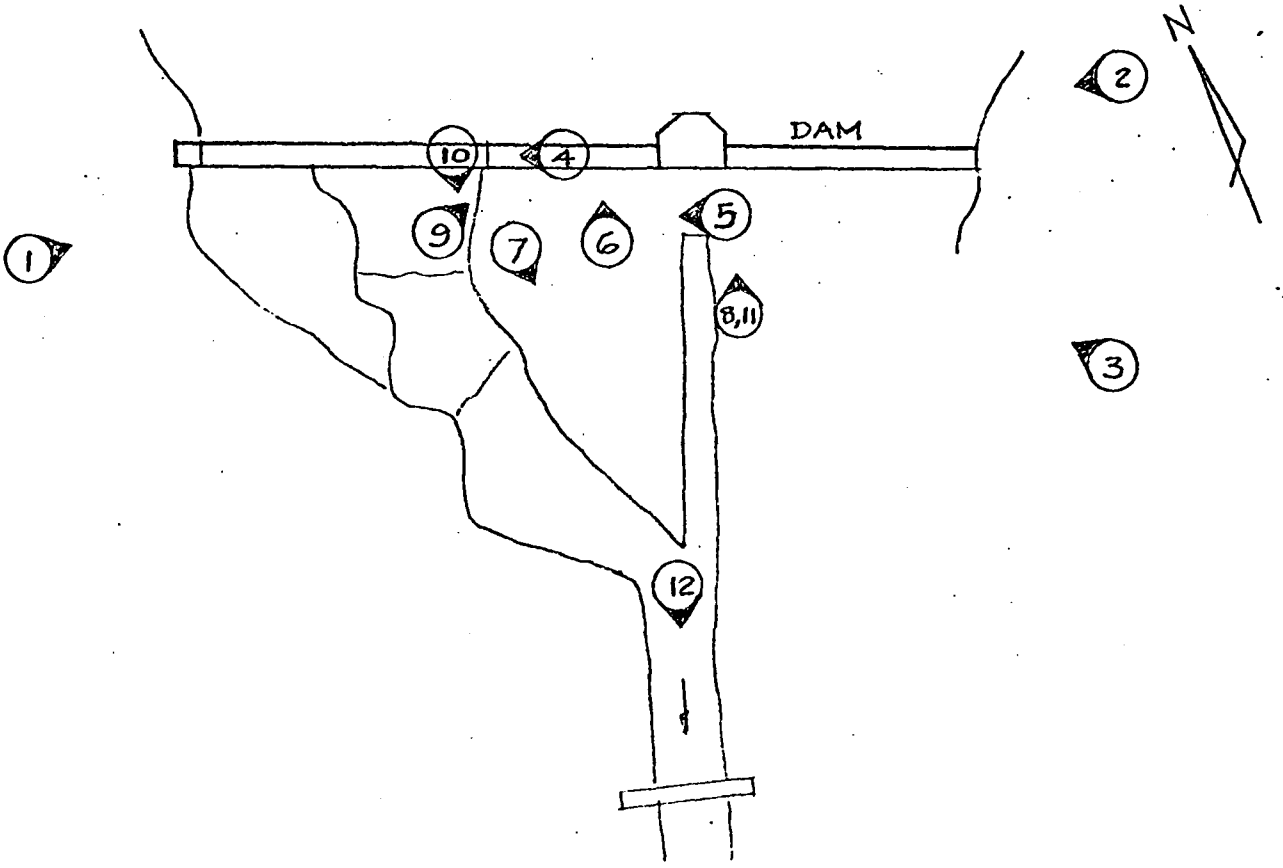
SECTION E-F

B-2

2

APPENDIX C

PHOTOGRAPHS



3 REFERS TO PHOTO NUMBER, LOCATION AND DIRECTION

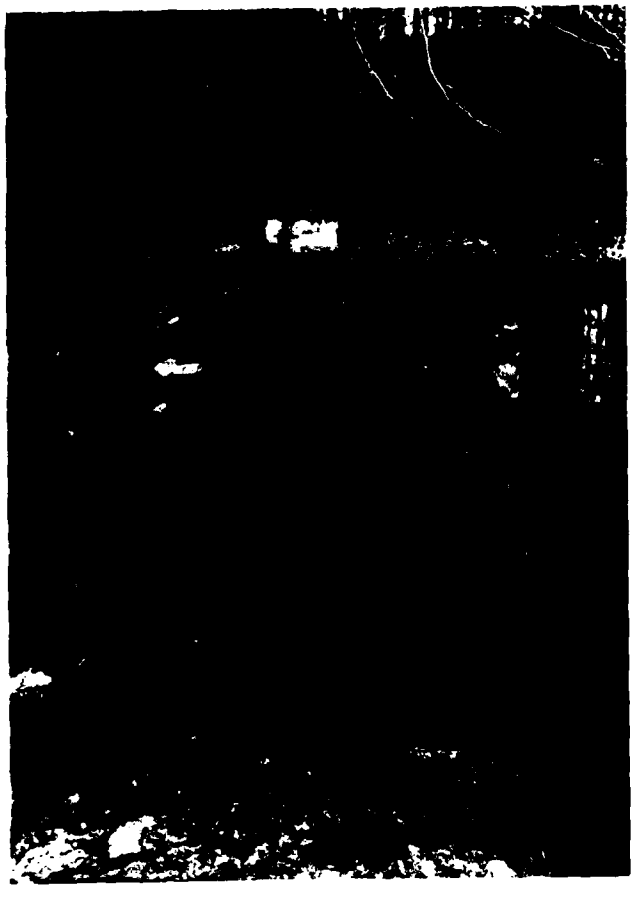
C-1

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	PHOTO LOCATION PLAN
PHILIP W. GENOVESE AND ASSOCIATES, INC. ENGINEERS – HAMDEN, CT.		BRANFORD SUPPLY PONDS DAM PISGAH BROOK BRANFORD, CONNECTICUT

1. Spillway and dam from right abutment.

2. Dam and Gatehouse from left abutment.

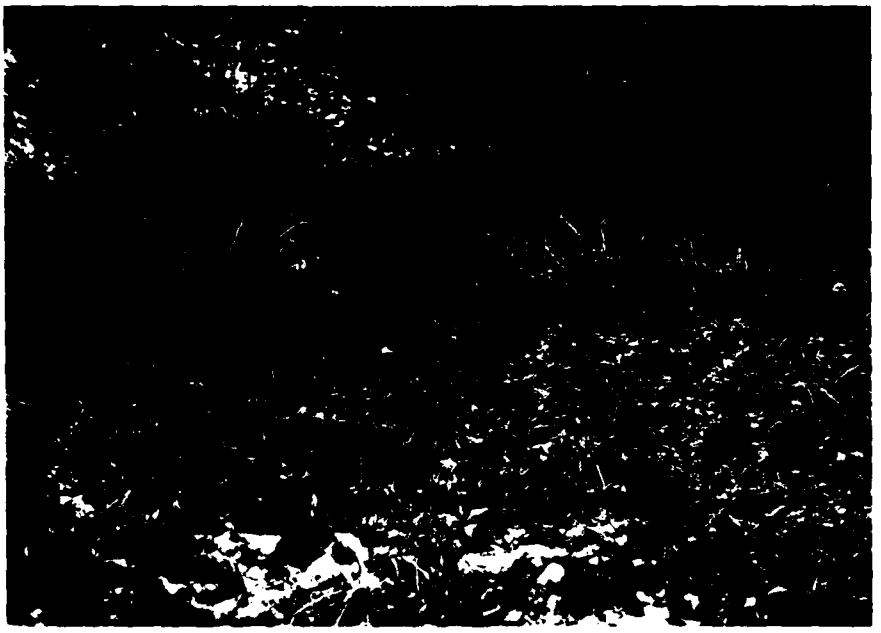
.3. Downstream dam face from left side of dam.



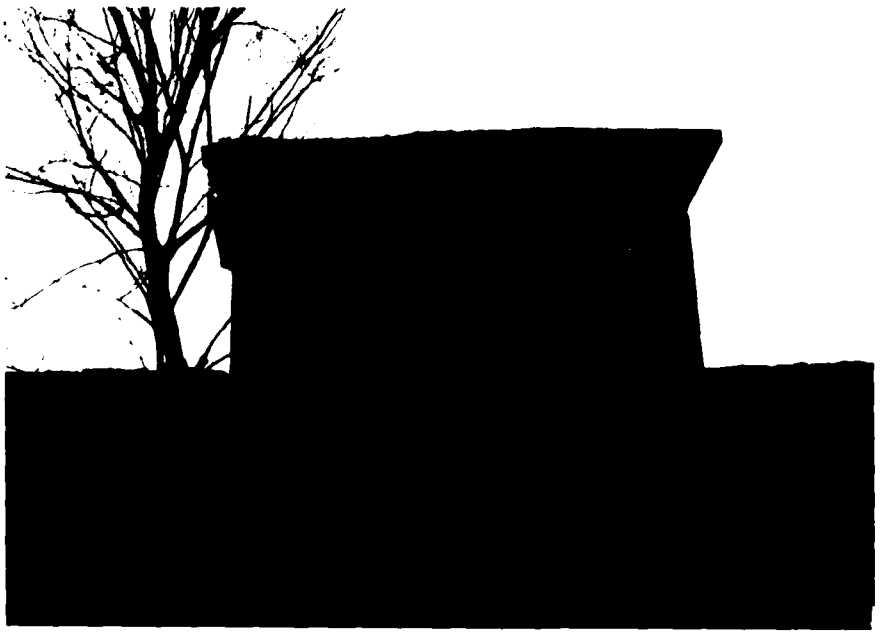
4. Spillway looking towards right abutment.

5. Downstream face of dam from downstream toe at about Sta 0+70 looking toward spillway.

6. Water seeping through downstream face of dam at about Sta 0+65 about 6 feet below crest.



7. Wet area at downstream toe of dam at about Sta 1+15.



8. Looking upstream at gatehouse. Note cracks and spalling of concrete on roof and at base.

9. Spalling on dam cap located to the right of the gatehouse.

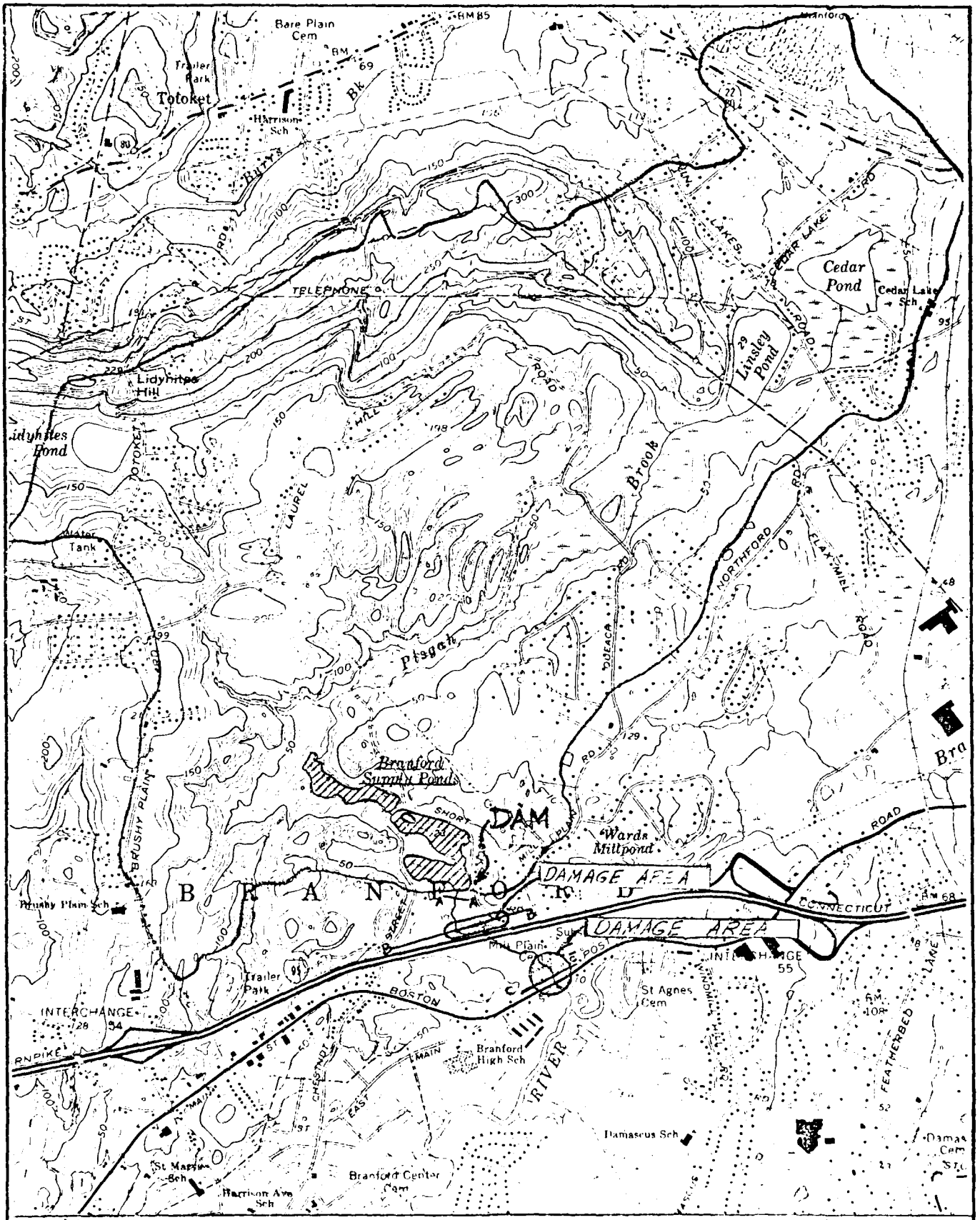
10. Spalling and cracks on left downstream spillway training wall.

11. Outlet Box.

12. Channel downstream of the dam.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



PHILIP W. GENOVESE & ASSOCIATES, INC.
ENGINEERS HAMDEN, CONNECTICUT

BRANFORD SUPPLY PONDS DAM (CT00116)

D-A

PERFORMANCE AT PEAK FLOOD CONDITIONS
PROBABLE MAXIMUM FLOOD (PMF) DETERMINATION

DRAINAGE AREA — 3.85 sq.Mi FROM CONN. DEP. BULLETIN No. 1, 1972 GAZETTEER OF NATURAL DRAINAGE AREAS. P. 46. (INCLUDING BOTH THE PONDS).

WATERSHED CLASSIFICATION - "ROLLING" TO "MOUNTAINOUS". SOME OF THE WATERSHED IS DEVELOPED FOR RESIDENTIAL USE AND REMAINDER MOSTLY WOODED BASED UPON USGS MAP AND SITE VISITS.

PMF PEAK INFLOW -

FROM THE CORPS OF ENGINEERS DEC. 1977 PEAK FLOW RATES GUIDE CURVES FOR A DRAINAGE AREA OF 3.85 sq.Mi FOR THE ABOVE DESCRIBED WATERSHED CLASSIFICATION AND RECOGNIZING THE EXISTENCE OF THREE PONDS AND SOME SWAMPLAND IN THE TRIBUTARY AREA,

THE SELECTED INTENSITY = 2000 CFS/sq.Mi

∴ PMF PEAK INFLOW = 2000 × 3.85 = 7700 CFS

SIZE CLASSIFICATION —

FOR THE PURPOSE OF DETERMINING PROJECT SIZE, THE MAXIMUM STORAGE ELEVATION IS CONSIDERED EQUAL TO THE TOP OF DAM

TOP OF DAM = EL. 24.5 NGVD* (Lowest crest elev.)
EMBANKED @ D/S TOE OF DAM = EL. 7.13**
HEIGHT OF DAM = 17.47 FT. SAY 17.5 FT

* THE U.S. ELEV. 23 M.S.L. IN THE BASIS FOR QUAD SHEET (PTC) IS ASSUMED APPROX. TO BE EQUIVALENT TO THE VERTICAL DATUM (NGVD). ALL OTHER ELEVATIONS ARE REFERENCED TO THIS ASSUMED ELEV. AND ARE OBTAINED BASED UPON INFORMATION FURNISHED BY F.W. CHERVENAK & ASSOC. INC.

** SEE SHEET D-2

PLANIMETERING FROM USGS MAP FOR POND SURFACE AREAS
AT EL 23 26 ACRES
AT EL 30 170 ACRES

A STAGE-POND AREA CURVE IS PLOTTED
FROM THIS CURVE POND AT SPILLWAY CREST (22.8) = 24 Ac.
FROM THIS CURVE, POND AREA AT TOP OF DAM = 60 Ac.
AVERAGE POND AREA BETWEEN SPILLWAY CREST
AND TOP OF DAM = 42 Ac.

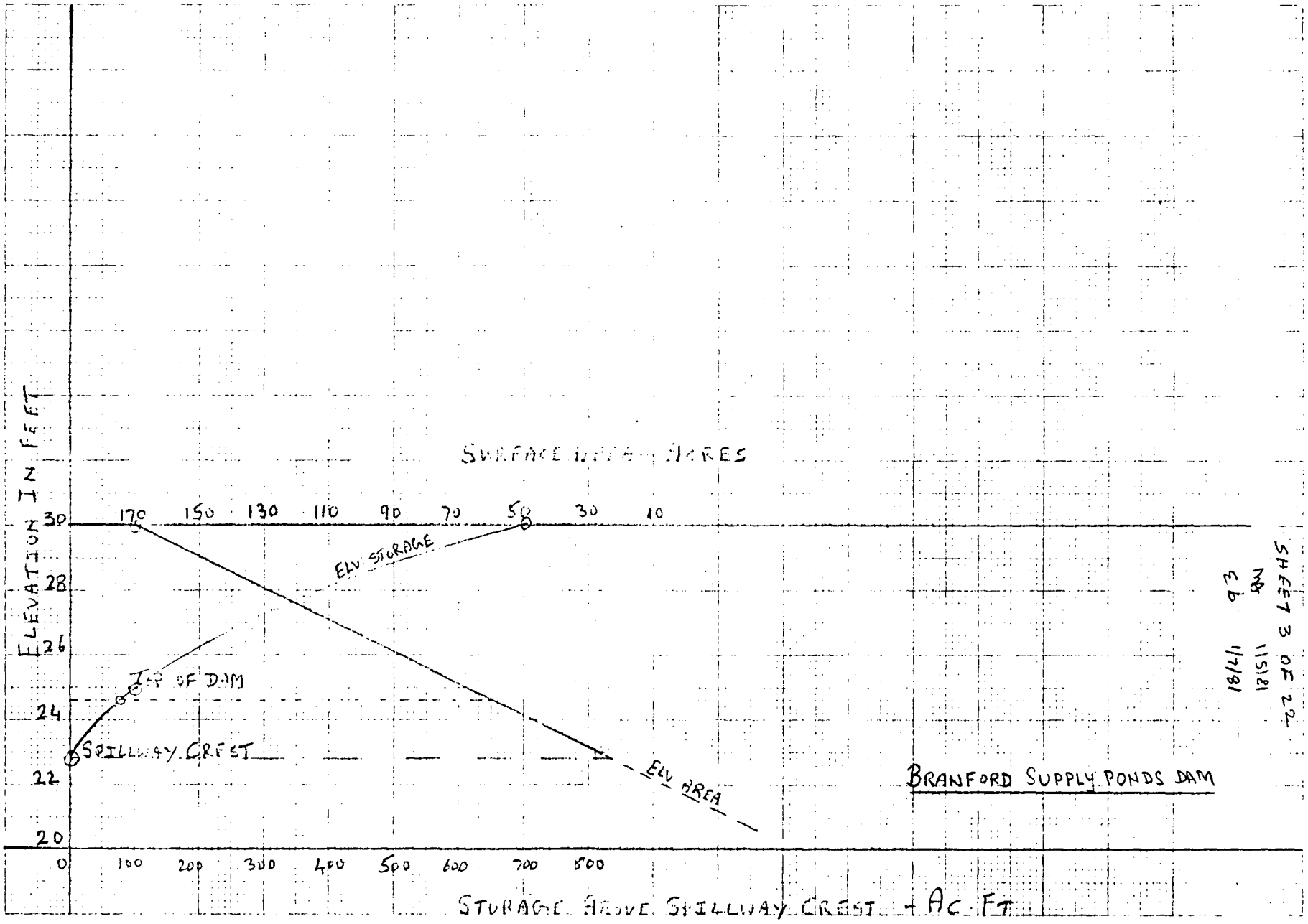
∴ STORAGE BETWEEN SPILLWAY CREST AND
TOP OF DAM = 1.8 × 42 ≅ 76 Ac.Ft.
ESTIMATED STORAGE BELOW SPILLWAY CREST
= $\frac{1}{3}$ × 24 × 15.67 = 126 Ac.Ft.

∴ MAXIMUM IMPOUNDMENT TO TOP OF DAM = 76 + 126
= 202 Ac.Ft.

A STAGE-STORAGE CURVE IS PLOTTED ON SHEET 3.

THUS, ACCORDING TO CORPS OF ENGINEERS GUIDELINES TABLE 1, THE BRANFORD SUPPLY PONDS DAM IS CLASSIFIED AS SMALL BASED UPON THE STORAGE CAPACITY WHICH IS 202 Ac.Ft (1000 AND > 50), THE HEIGHT BEING ONLY 17.5 Ft.

** According to Corps of Engineers Recommended Guidelines for Safety Inspection of Dams, the height of the dam is established with respect to the maximum storage potential measured from the natural bed of the stream or watercourse at the downstream toe of the barrier. The Brook bed elevation at the D/S toe of the dam could not be measured; however it is estimated to be 7.13 based upon the Brook bed elevation measured 15' from the dam (7.01), and the channel slope (.01%) estimated from USGS map information.



BRANFORD SUPPLY PONDS DAM

SHEET 3 OF 22
NAE
11/5/81

D-3

HAZARD POTENTIAL — SIGNIFICANT HAZARD POTENTIAL BASED UPON DAM BREACH ANALYSIS AND RELATIVE LOCATIONS OF HOUSES AND OTHER STRUCTURES. A DETAILED DISCUSSION OF FAILURE HAZARD POTENTIAL IS INCLUDED AT THE END OF BREACH ANALYSIS SECTION OF APPENDIX-D.

SELECTION OF TEST FLOOD —
FOR THE SMALL SIZE AND SIGNIFICANT HAZARD POTENTIAL CLASSIFICATION, TABLE 3 OF CORPS OF ENGINEERS RECOMMENDED GUIDELINES, THE TEST FLOOD COULD BE IN THE 100 YR TO $\frac{1}{2}$ PMF RANGE.

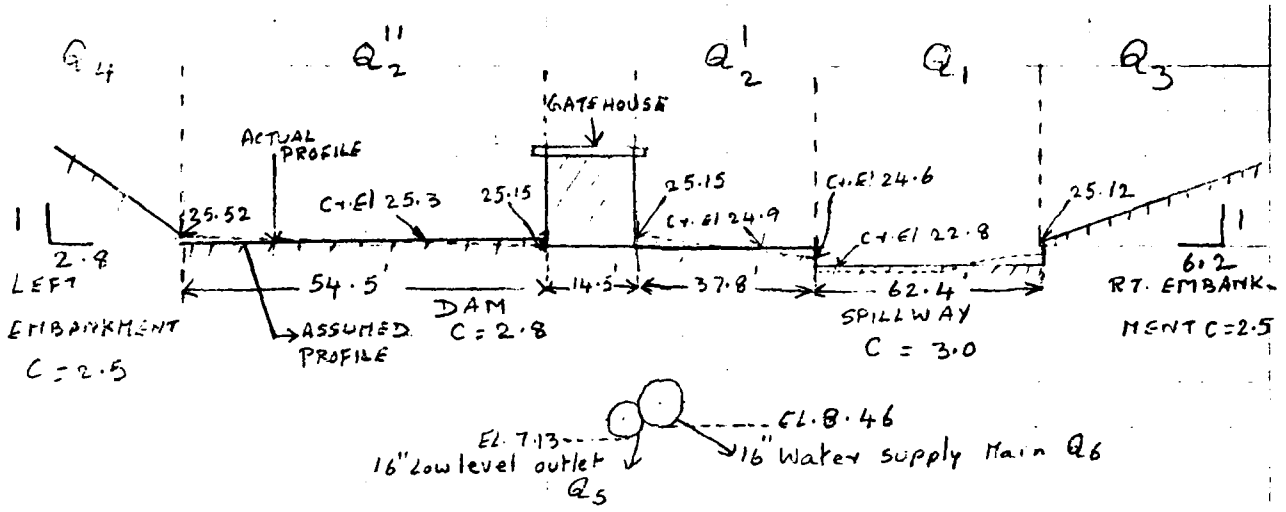
BASED UPON THE INVOLVED RISK POTENTIAL DOWN-STREAM OF THE DAM, LOWER END OF THIS RANGE IS SELECTED.

TEST FLOOD = 100 YR

TEST FLOOD PEAK INFLOW = $\frac{5"}{19"} \times 7700 \simeq$ 2030 CFS

NOTE: PMF of 7700 CFS would result from 19" Run-off and a 100 year flood in Connecticut would result from approximately 5" Run-off.

COMPOSITE DISCHARGE RATING CURVE



APPROXIMATE POTENTIAL OVERFLOW PROFILE

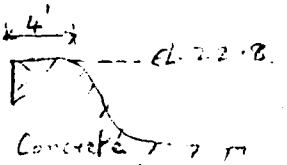
(SPILL. & DAM PROFILES BASED ON P.N. GENOVESE & ASSO. INC. FIELD INFORMATION)

SPILLWAY

$Q_1 = CLH^{3/2}$ Cr. El 22.8

$L = 62.4'$

$= 187.2 H^{3/2}$ $C = 3.0$ Broad crested weir



(Per Fig 7. of USGS Book 3. Chapter A5 of "Measurements of Peak Discharge at Dams by Indirect Methods" 1968)

DAM

$Q_2' = CLH^{3/2}$ Cr. El = 24.9

$= 105.8 H^{3/2}$ $L = 37.8'$

$C = 2.8$ (stone Broad crested)

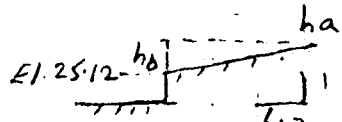
$Q_2'' = 152.6 H^{3/2}$ Cr. El 25.3 $C = 2.8$ $L = 54.5'$

$Q_2 = Q_2' + Q_2''$

RIGHT EMBANKMENT

$$Q_3 = \frac{2}{5} \frac{CL\left(h_b^{5/2} - h_a^{5/2}\right)}{(h_b - h_a)} *$$

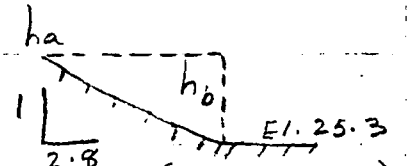
$$= 6.2\, h_b^{5/2}$$



C = 2.5 (stone, uneven)
ha = 0 for the condition.

LEFT EMBANKMENT

SIMILARLY $Q_4 = 2.8\, h_b^{5/2}$



C = 2.5 (stone, uneven)
ha = 0 for the condition

LOW-LEVEL OUTLET PIPE

$Q_5 = CA\sqrt{2gH}$ Pipe Dia 16" ⊙ Center El. 7.8, El. 7.13

$= 11.1\sqrt{H}$ NEGLECTING LOSSES

= 45 CFS FOR POOL AT TOP OF DAM (El. 24.6)

SUPPLY MAIN

$Q_6 = CA\sqrt{2gH}$ Pipe Dia 16" ⊙ Center El. 9.13, El. 8.46

= 43 CFS FOR POOL AT TOP OF DAM. (Based on Aug 1972 Drawing of Gatehouse)

* USGS Recommended formula for more precise discharge over lined dam/embankment crest (Ref: Measurement of Peak Discharges at dam by Indirect Methods USGS Book 3, Chapter A-5, Page 3-4, 1978)

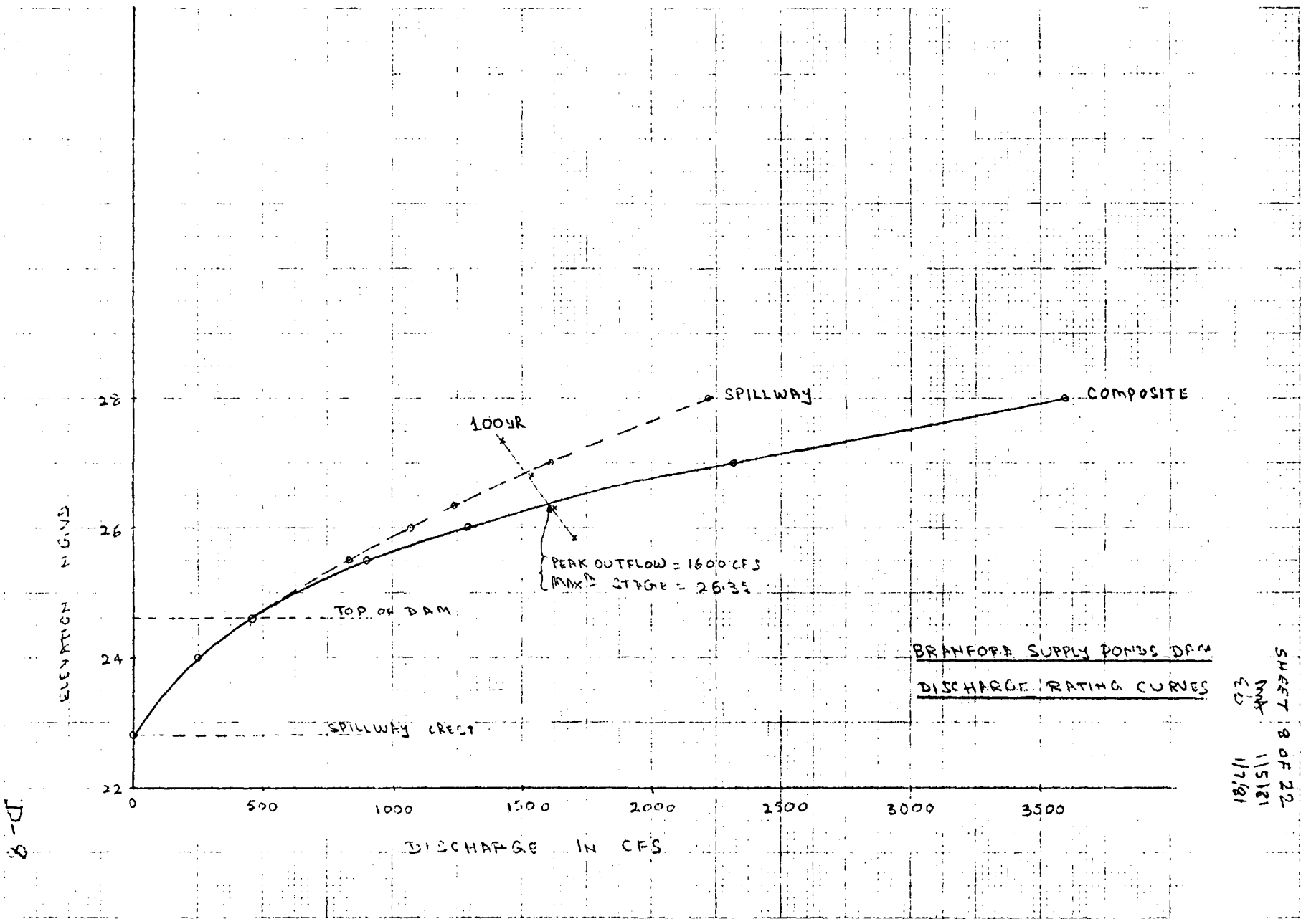
PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-13-10 SHEET 7 OF 22
NEW ENGLAND DIVISION COMPUTED BY MA DATE 1/5/81
BRANFORD SUPPLY PONDS DAM CHECKED BY Eb DATE 1/7/81

TABULATION OF DISCHARGE RATES (CFS)

	ELVN NGVD	SPILLWAY Q_1	DAM Q'_2	DAM Q''_2	TOTAL DAM Q_2	RT. EMB Q_3	LEFT EMB Q_4	TOTAL Q
SP.CR	22.8	0	—	—	—	—	—	—
	24.0	246	0	0	0	0	0	246
TOD	24.6	450	0	0	0	0	0	450
	25.5	830	49	14	63	1	0	894
	26.0	1072	122	89	211	4	1	1288
	27.0	1611	322	338	660	30	11	2312
	28.0	2220	577	677	1254	87	34	3595
TEST FLOOD	26.35	1247	180	160	340	10	3	1600

NOTE: CONSIDERING THE ABOVE OVERFLOW CAPACITIES, THE DISCHARGE CAPACITIES OF LOW LEVEL OUTLET AND SUPPLY MAIN ARE NEGLECTED.

DISCHARGE RATING CURVES FOR TOTAL Q (COMPOSITE) AND SPILLWAY ARE PLOTTED ON NEXT SHEET.



BRANFORD SUPPLY PONDS DAM

DISCHARGE RATING CURVES

SHEET 8 OF 22

MAT 1/15/81

CD 1/7/81

D-8

DETERMINATION OF PEAK OUTFLOW

SHORTCUT ROUTING OF RESERVOIRS
CORPS OF ENGINEERS GUIDELINES "SURCHARGE STORAGE ROUTING" ALTERNATE METHOD USED.
FOR 2030 CFS (100 YR) THE DISCHARGE RATING CURVE GIVES ELVN = 26.8
AND FROM STAGE - STORAGE CURVE FOR THIS ELVN
STORAGE = 250 AC·FT

$$STOR_i = \frac{250 \times 12}{3.85 \times 640} = 1.22''$$ RUN-OFF

$$Q_{P_i} = Q_{P_1}\left(1 - \frac{STOR_i}{5}\right)$$

① STOR, INCHES	② $(1 - \frac{STOR_i}{5})$	③ STOR AC.FT ① $\times \frac{3.85 \times 640}{12}$	④ Q_{P_i} CFS ② $\times$ 2030	⑤ ELVN FROM STORAGE CURVE USING ③
0.8	0.84	164	1705	25.85
1.0	0.80	205	1624	26.3
1.22	0.756	250	1535	26.8
1.5	0.70	308	1421	27.35

COLUMN ④ AND ⑤ ARE PLOTTED ON DISCHARGE RATING CURVE AND

PEAK OUTFLOW Q = 1600 CFS
MAXIMUM STAGE = 26.35 MSVD
∴ THE DAM IS OVERTOPPED BY 1.75 FT.

BREACH ANALYSIS — DOWNSTREAM FAILURE HAZARD:
BASED UPON CORPS OF ENGINEERS "RULE OF THUMB" GUIDANCE FOR ESTIMATING D/S DAM FAILURE HYDROGRAPHS

BREACH OUTFLOW $Q_b = \frac{8}{27} \times W_b \times \sqrt{g} \times y_o^{3/2}$

TOTAL HEIGHT FROM BROOKBED TO POOL LEVEL @ FAILURE y_o = 17.5' WITH POOL AT TOP OF DAM

ESTIMATED BREACH WIDTH W_b = 40% OF MID-HT. LENGTH OF DAM = 0.4 × 85' = 34'

(MID-HT. LENGTH IS BASED UPON PW GENOVESE & ASSOC. INC'S DEC. 10, 1980 FIELD INFORMATION).

$\therefore Q_b = \frac{8}{27} \times 34 \times \sqrt{32.2} \times (17.5)^{3/2} \cong 4200$ CFS

PEAK FAILURE OUTFLOW $Q_{P_f} = Q_b$ + SPILLWAY DISCHARGE
= 4200 + 450 = 4650 CFS
SAY 4700 CFS

(IT IS PRESUMED THAT THE BREACH OCCURS IN DEEPEST SECTION OF THE DAM. THIS SECTION INCLUDES THE GATEHOUSE, WATER SUPPLY MAIN AND LOW LEVEL OUTLET).

ESTIMATED FAILURE FLOOD DEPTH IMMEDIATELY D/S FROM DAM $\cong 0.44 y_o \cong 7.7$ FT

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS
NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-13-10 SHEET 11 OF 22
NEW ENGLAND DIVISION COMPUTED BY [illegible] DATE 1/5/81
BRANFORD SUPPLY PONDS DAM CHECKED BY EB DATE 1/7/81

PERFORM D/S ROUTING OF PEAK FAILURE OUTFLOW

SECTION AA IS SELECTED 100' D/S OF THE DAM AND SECTION BB IS SELECTED 500' D/S OF SECTION AA USING MANNING'S EQUATION

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$ where n = 0.07 Assumed (stones, windy) and S = 0.004 Est. from USGS Map

$$= 1.34 A R^{2/3}$$

A AND R ARE ESTIMATED BASED UPON USGS MAP INFORMATION IN THIS PARTICULAR REACH, AVERAGE VALUES OF SECTION AA & BB ARE USED TO OBTAIN STAGE-AREA AND STAGE-DISCHARGE CURVES FOR BETTER ESTIMATION.

ELVN	A SQ. FT. SECTION AA		P SECTION AA	BB	A AVGE	P AVGE	R	$R^{2/3}$	Q CFS
	AA	BB							
8	—	0	—	—	0	—	—	—	—
10	0	175	—	175	87.5	87.5	1	1	117
15	220	3362	88	1200	1791	644	2.8	1.93	4,750
20	875	11050	175	2000	5962	1087	5.5	3.1	24,770

LENGTH OF THE FIRST REACH = 600' (AA TO 1-75 [illegible]) FROM STAGE-DISCHARGE AND STAGE-AREA CURVES OF SECTION AA AND BB COMBINED CURVES)

FOR QP_1 = 4700 CFS. ELVN = 15.15 AND AREA [illegible]

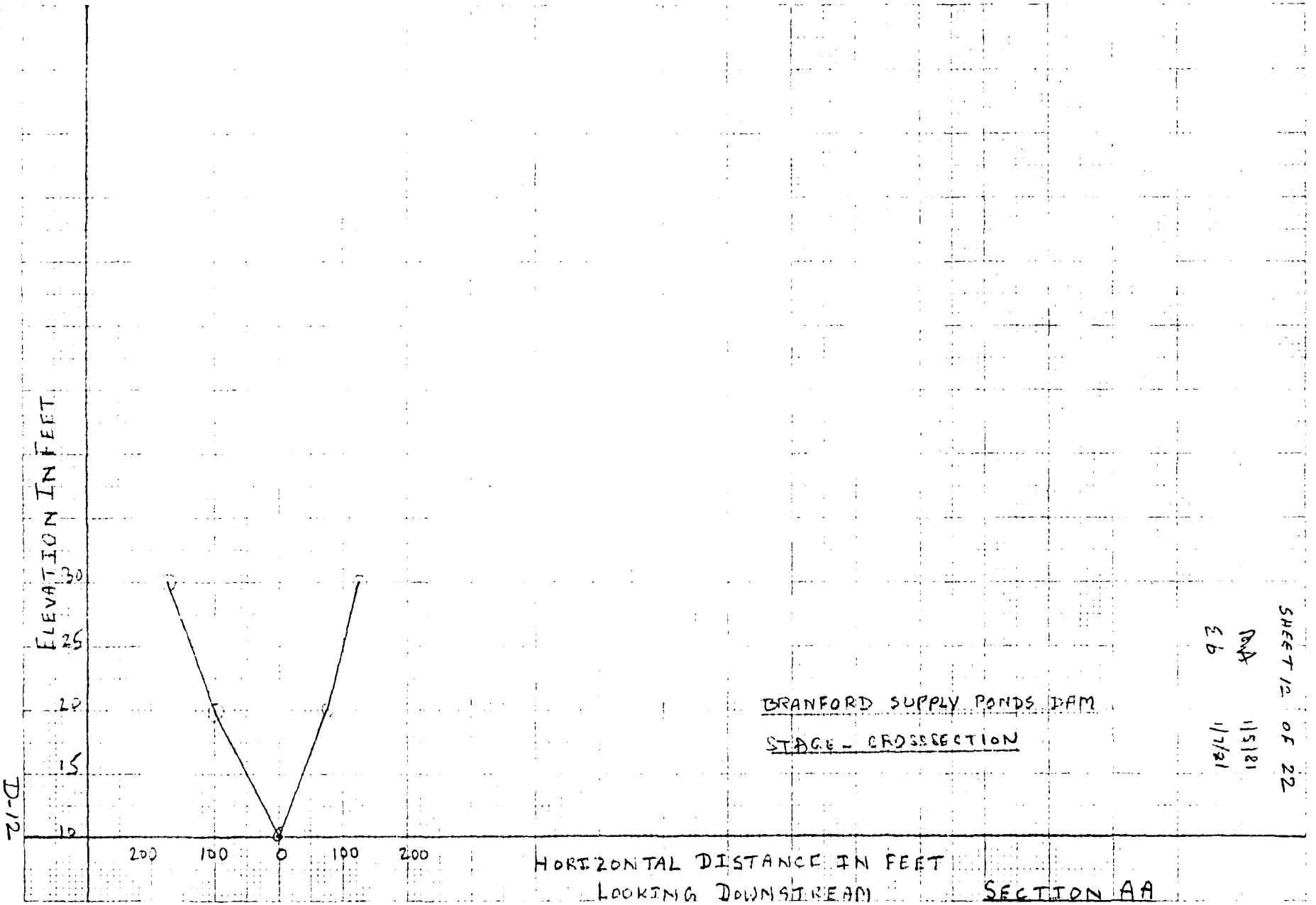
VOLUME OF REACH $V_1 = \frac{600 \times 1860}{43,560}$ = 25[illegible]

TRIAL $QP_2 = QP_1 \left(1 - \frac{V_1}{S}\right)$, WHERE S = [illegible]

$$= 4700 \left(1 - \frac{25.6}{202}\right) = 41[illegible]$$

FOR THIS QP_2 THE STORAGE-DISCHARGE [illegible] GIVES ELVN = 14.9 AND AREA = 1140

VOLUME OF REACH $V_2 = \frac{600 \times 1140}{43,560}$ = [illegible]



BRANFORD SUPPLY PONDS DAM

STAGE - CROSSECTION

SECTION AA

12/7/81

BWA

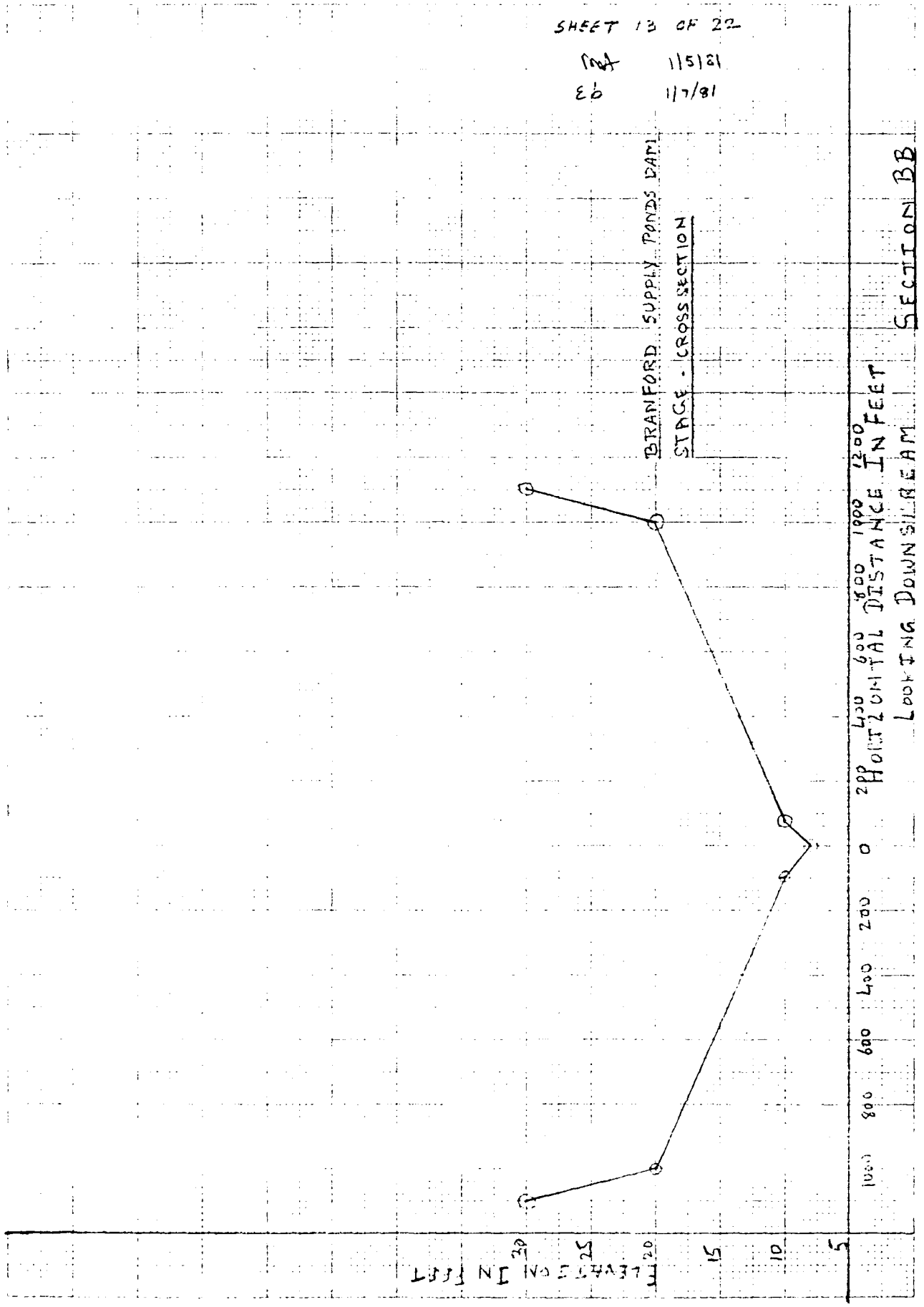
SHEET 12 OF 22

D-12

SHEET 13 OF 22

RAF 1/5/81

EB 1/7/81



20 Squares to the Inch

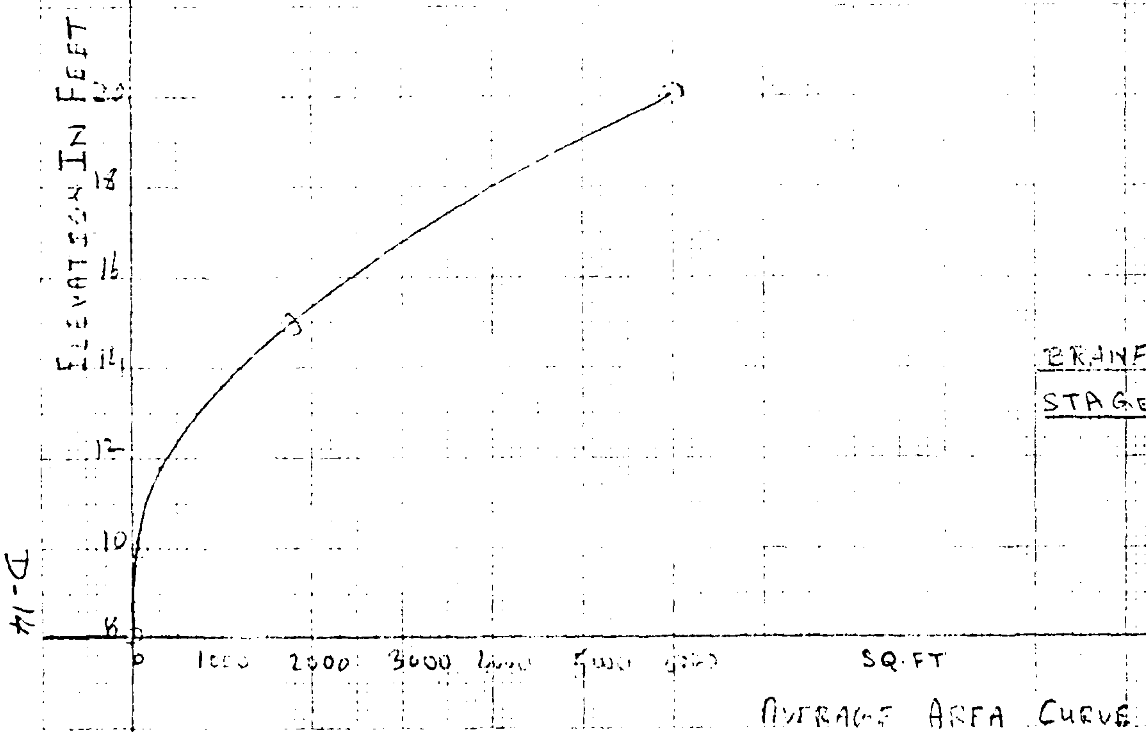
SHEET 14 OF 22

[initials] 1/5/81

93 1/7/81

BRANFORD SUPPLY PONDS DAM

STAGE - AREA CURVE



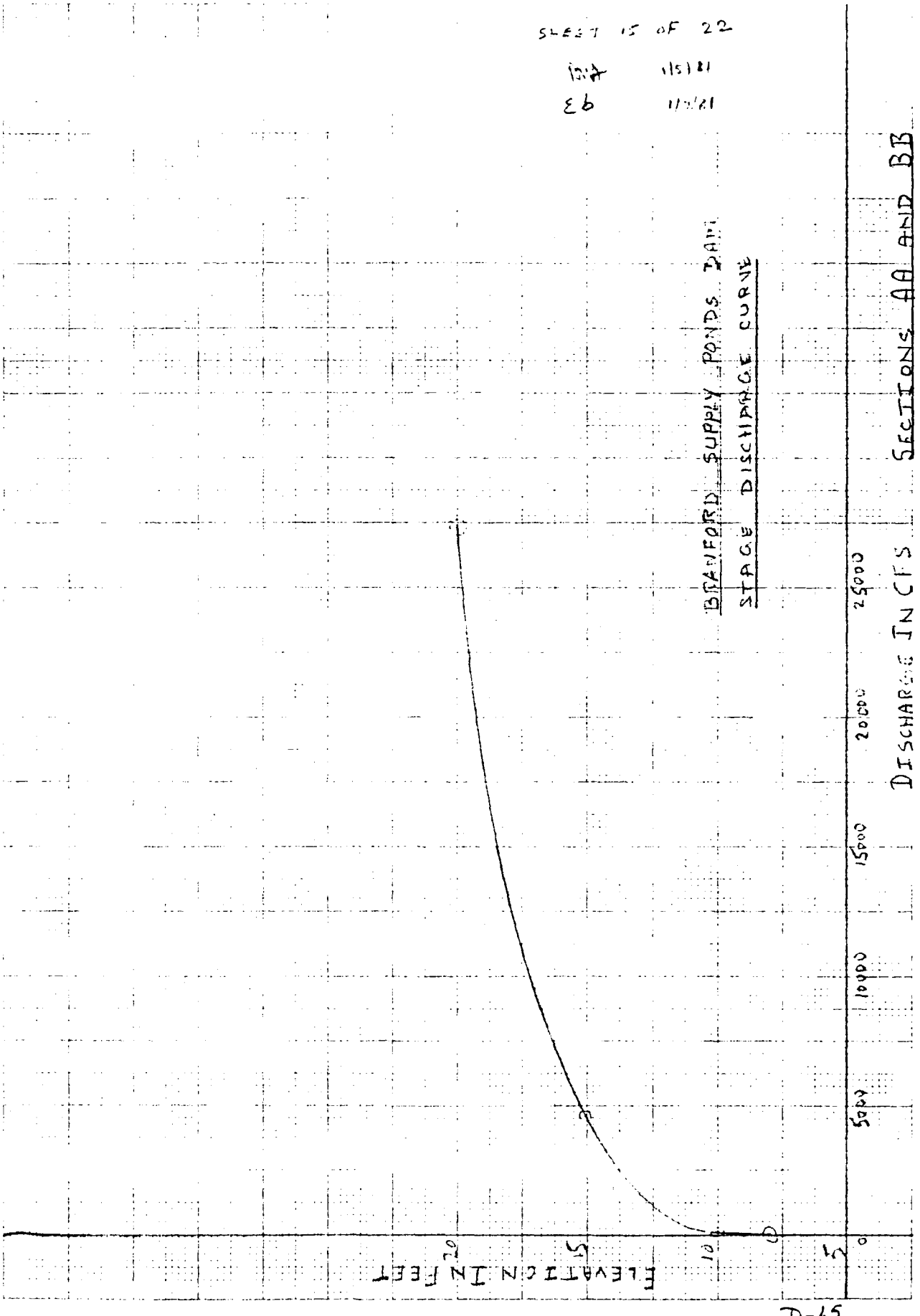
SECTION AA AND SECTION BB

20 Squares to the Inch

SHEET 15 OF 22

DATE 11/5/81

EB 11/5/81



RECOMPUTING $Q_{P_2} = 4700\left(1 - \frac{\frac{25.6+22.6}{2}}{202}\right) = 4140$ CFS

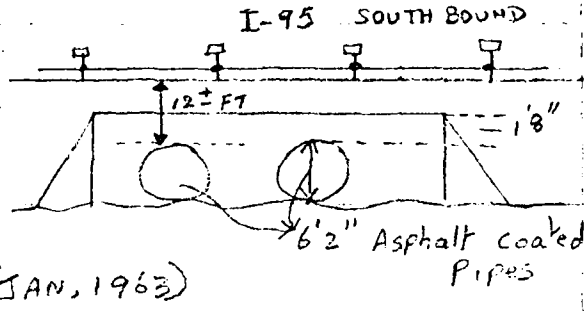
FLOOD STAGE = 14.8 NGVD

FLOOD DEPTH = 14.8 − 8.0 = 6.8 FT

VELOCITY = $\frac{4140}{1640}$ = 2.5 FPS

THE 1ST FLOOR OF A BROWN COLONIAL HOUSE LOCATED EAST OF THE BROOK ON SHORT ROCKS Rd. IS 9± FT ABOVE THE CHANNEL BED. THUS, THE BASEMENT OF THIS HOUSE AND 2 OTHER HOUSES IN THE VICINITY WOULD BE FLOODED WITH 4 TO 5 FT. OF WATER. ONE OF THESE THREE HOUSES IS A LOG-CABIN WHICH COULD BE SERIOUSLY IMPACTED.

HIGHWAY CULVERT—
IMMEDIATELY BELOW SECTION BB, I-95 HIGHWAY CULVERT EXISTS WITH TWO 6'2" DIAMETER ASPHALT COATED PIPES WITH CONCRETE HEADWALLS. PER U S BUREAU OF PUBLIC ROADS (JAN, 1963) NOMOGRAPH FOR $\frac{HW}{D} = \frac{81.6}{74} = 1.1$ FROM SCALE 2



(REV. MAY 1964) DISCHARGE CAPACITY OF EACH PIPE = 260 CFS.
∴ TOTAL DISCHARGE CAPACITY FOR 2 PIPES = 520 CFS
WHICH IS INADEQUATE TO CONVEY THE PEAK OUTFLOW OF 4140 CFS FROM THE 1ST REACH.
THUS, THE WATER DEPTH U/S OF THE HWY EMBANKMENT WOULD INCREASE FURTHER. HOWEVER, THE DAMMING EFFECT OF THE EMBANKMENT WOULD NOT INCREASE THE FLOOD DEPTH HIGH ENOUGH SO AS TO CAUSE DAMAGE TO FIRST FLOORS OF THE HOUSES IN THE VICINITY AND THE HIGHWAY EMBANKMENT IS HIGH ENOUGH TO PREVENT OVERTOPPING.

REACH 2

(TOE OF THE NORTH BOUND I-95 EMBANKMENT TO SECTION CC WITH A REACH LENGTH OF 1000 FT).

$Q = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$

$= 0.87 \times A \times R^{2/3}$

$n = 0.09$ Assumed (sluggish, weedy, per Table 5-6, Pg 112, open channel Hydraulics by Ven Ten Chow)

and $S = 0.0028$ Est. from USGS Map

ELV	A Sq. Ft	P	R	$R^{2/3}$	Q CFS
2	0	—	—	—	—
5	309	206	1.5	1.31	352
10	2200	550	4	2.52	4823

FROM STAGE AREA AND STAGE DISCHARGE CURVES FOR $Q P_1 = 4140$ CFS, ELVN = 9.7 AND FROM STAGE AREA CURVE, AREA = 2020 Sq. Ft.

VOLUME OF REACH $= \frac{1000 \times 2020}{43,560} \cong 46.4$ Ac. Ft.

TRIAL $Q P_2 = Q P_1 \left(1 - \frac{V_1}{S}\right)$

$= 4140 \left(1 - \frac{46.4}{202^*}\right) = 3190$ CFS

FOR 3190 CFS, ELVN = 9.2 AND AREA = 1780

$\therefore V_2 = \frac{1000 \times 1780}{43,560} = 40.9$ Ac. Ft

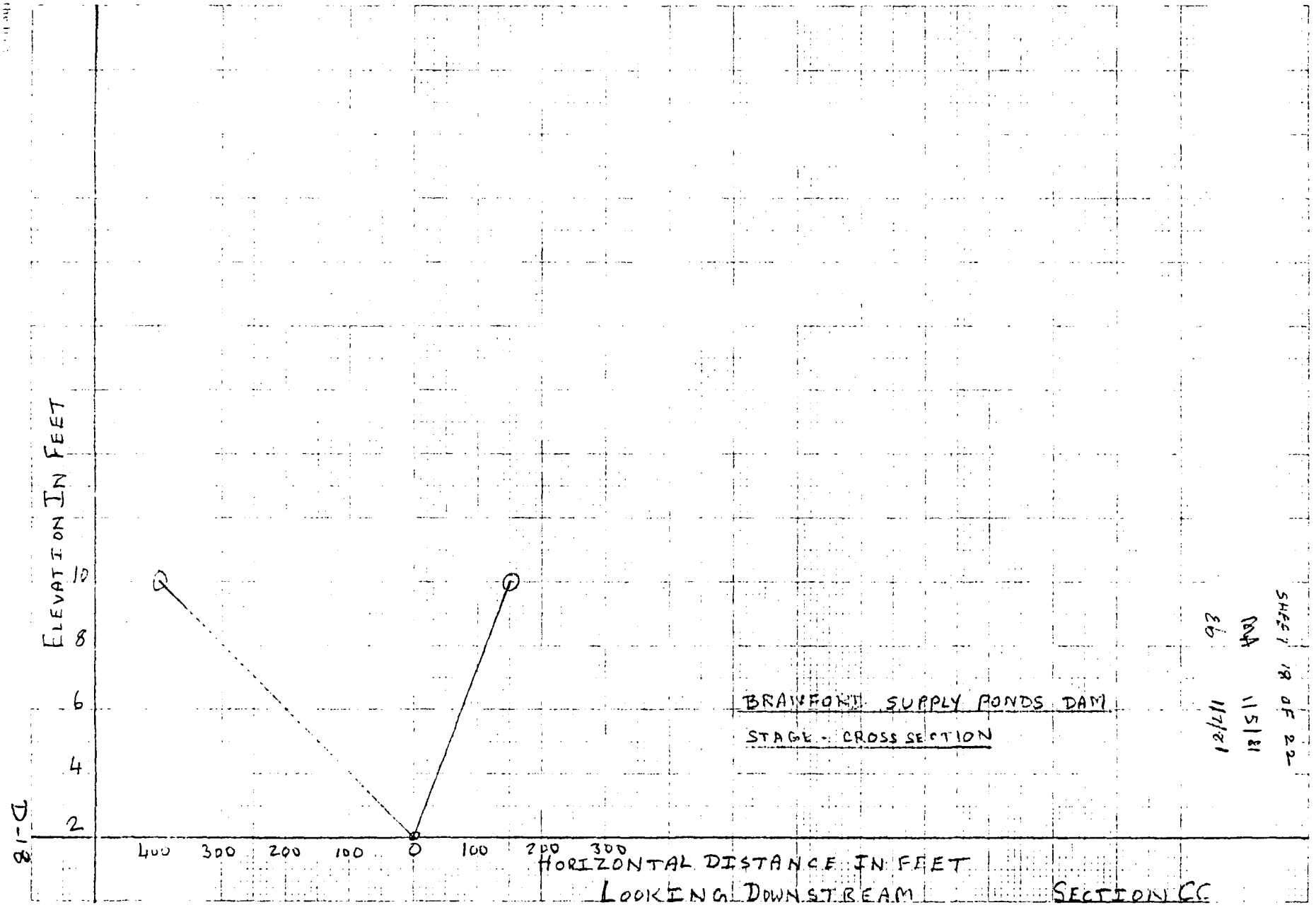
RECOMPUTING $Q P_2 = 4140 \left(1 - \frac{\frac{46.4 + 40.9}{2}}{202}\right) \cong 3250$ CFS

FLOOD STAGE = 9.2 NGVD

DEPTH OF FLOOD WATER: EL 9.2 − EL 2 = 7.2 FT.

VELOCITY $= \frac{3252}{1780} \cong 1.9$ FPS

* The 24.1 Ac. Ft. attenuated storage volume is neglected.



BRAWFORD SUPPLY PONDS DAM

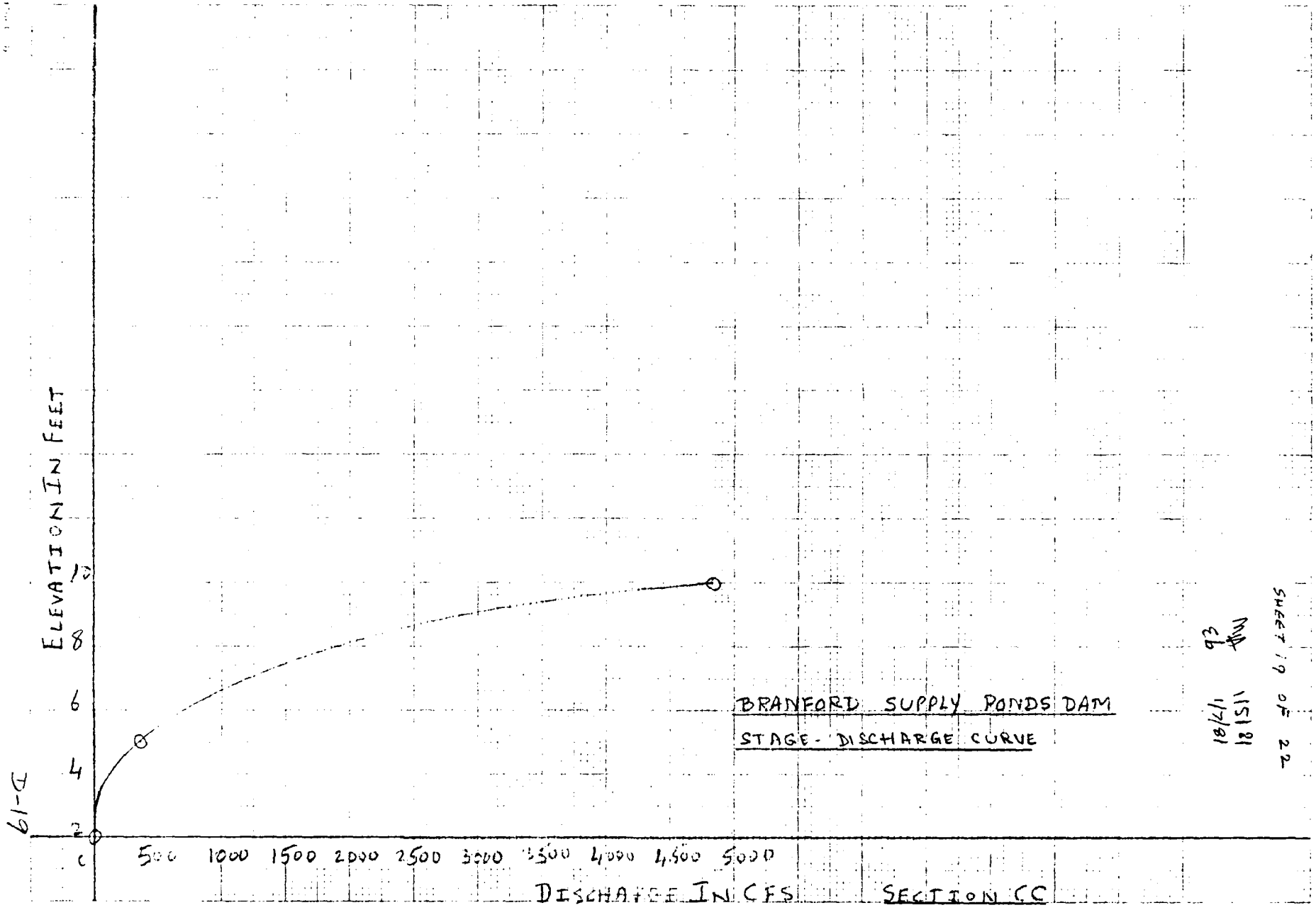
STAGE - CROSS SECTION

12/4/11 93

MM 1 5 1 81

SHEET 18 OF 22

D-18



BRANFORD SUPPLY PONDS DAM

STAGE - DISCHARGE CURVE

SECTION CC

10/4/11 93 #W

18151

SHEET 19 OF 22

D-19

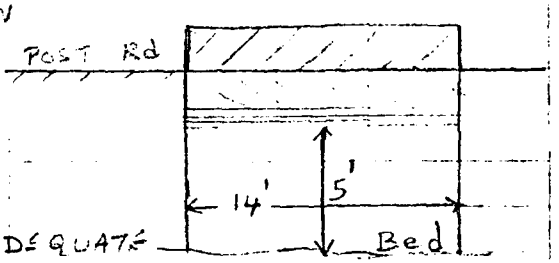
THE 1ST FLOOR OF TWO HOUSES ON MILL PLAIN ROAD ARE 6± FT ABOVE THE BROOK AND THEREFORE WOULD BE SUBJECT TO 1± FT OF FLOODING. THREE BUILDINGS ON BOSTON POST ROAD LOCATED ADJACENT TO THE BROOK ARE LOCATED 8± FT ABOVE THE BROOK. HOWEVER, BASEMENTS OF THESE BUILDINGS COULD HAVE FLOODING.

IN ADDITION, BOSTON POST RD. AND THE CULVERT COULD HAVE FLOOD IMPACT.

DISCHARGE CAPACITY Q = 700 CFS

BASED ON FIG 17-29, P. 498 OPEN CHANNEL HYDRAULICS, BY VEN TE CHOW

FOR $\frac{H}{d} = \frac{7.2}{5} = 1.44$



THUS, THE CULVERT HAS INADEQUATE CAPACITY FOR THE PEAK INFLOW IN REACH 2 AND THE POST RD COULD BE SUBJECT TO SUBMERGENCE. HOWEVER, DUE TO DAMMING EFFECT, THE INCREASE IN FLOOD DEPTH UPSTREAM IS NOT LIKELY TO BE SIGNIFICANT.

FAILURE HAZARD POTENTIAL

BASED UPON THE FIELD INFORMATION, THE LOWEST SECTION OF THE DAM APPEARS TO BE IN THE VICINITY OF GATEHOUSE AND HENCE IT IS PRESUMED THAT BREACH OF THE DAM WOULD OCCUR IN THIS VICINITY. THE FAILURE ANALYSIS WAS PERFORMED WITH POOL AT TOP OF DAM (EL. 24.6 NGVD).

SUMMARY OF BREACH ANALYSIS RESULTS

LOCATION	DISTANCE FROM DAM FT	PEAK FLOW RATE CFS	FLOOD STAGE	FLOOD DEPTH	VELOCITY FPS
DAM	0	4700	14.8	7.7	—
BB	600	4140	14.8	6.8	2.5
CC	2400	3250	9.2	7.2	1.9

AT DAM FAILURE, 3 HOUSES ON SHORT ROCKS RD. IN THE VICINITY OF SECTION BB WOULD BE SUBJECT TO BASEMENT FLOODING BY 4 TO 5 FT. OF WATER. ALSO, I-95 HIGHWAY CULVERT HAS INADEQUATE CAPACITY TO PASS THE PEAK FAILURE OUTFLOW.
FURTHER, D/S IN THE VICINITY OF SECTION CC, TWO HOUSES WOULD BE SUBJECT TO 1ST FLOOR FLOODING BY 1 FT. OF WATER AND 3 OTHER BUILDINGS MAY BE SUBJECT TO BASEMENT FLOODING. IN ADDITION, THE CULVERT ON BOSTON POST RD. HAS INADEQUATE CAPACITY TO PASS THE PEAK FAILURE OUTFLOW.

THUS, DAM FAILURE HAS A POTENTIAL FOR CAUSING LOSS OF A FEW LIVES AND DAMAGE TO SEVERAL STRUCTURES. HENCE, A HAZARD POTENTIAL OF SIGNIFICANT MAGNITUDE IS CONSIDERED LIKELY.

SUMMARY - HYDRAULICS/HYDROLOGIC COMPUTATIONS

PERFORMANCE AT PEAK FLOOD CONDITIONS:

PEAK INFLOW (100 YR)	2030 CFS
PEAK OUTFLOW	1600 CFS
SPILL. CAP.TO TOP OF DAM (EL.24.6NGVD)	450 CFS
SPILL. CAP.TO TOP OF DAM % OF PEAK OUTFLOW	28
SPILL. CAP.TO PEAK FLOOD ELVN (26.35 NGVD)	1247 CFS
SPILL. CAP. TO PEAK FLOOD ELVN % OF PEAK OUTFLOW	78

PERFORMANCE:

MAXIMUM POOL ELVN	26.35NGVD
MAX. SURCHARGE HEIGHT ABOVE SPILL.CR	3.55 FT
NON OVERFLOW SECTION OF THE DAM (24.6NGVD)OVERTOPPED	1.75 FT

DOWNSTREAM FAILURE CONDITIONS :

PEAK FAILURE OUTFLOW	4700 CFS
FLOOD DEPTH IMMEDIATELY D/S FROM DAM	7.7 FT
CONDITIONS AT FIRST DAMAGE AREA (SECTION BB):	
ESTIMATED STAGE BEFORE FAILURE WITH 450 CFS	11.5 NGVD
ESTIMATED STAGE AFTER FAILURE WITH 4140 CFS	14.8 NGVD
ESTIMATED RAISE IN STAGE AFTER FAILURE ΔY_1	3.3 FT
CONDITIONS AT THE SECOND DAMAGE AREA (SECTION CC):	
ESTIMATED STAGE BEFORE FAILURE WITH 450 CFS	5.4 NGVD
ESTIMATED STAGE AFTER FAILUPE WITH 3250 CFS	9.2 NGVD
ESTIMATED RAISE IN STAGE AFTER FAILURE ΔY_2	3.8 FT

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME